Technology and International Student Parenting: Implications for Research and Design of Digital Childcare Technologies

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(ABSTRACT)

Digital technologies such as televisions, touch screen tablets, smartphones, and smart speakers are now frequently encountered and used by young children even before the age of one. These devices facilitate modern parents in their caregiving of young children due to their prevalence in the home environment. The use of these devices is especially common by international student mothers of young children who subscribe to a multiplicity of roles such as being a productive student, efficient mother, and dutiful partner in a new country. This dissertation summarizes four studies exploring the role of technology in international student mothers' lives as parents of young children, and the implications for the design and research of technologies for parents based on the transferable learning from these studies. The first and second studies employ autoethnographic and participatory approaches to involve these mothers as equal stakeholders and collaborators to understand the context of their use of technology. The third and fourth studies explore the various uses of technology by caregivers and young children, to obtain certain gratifications.

By engaging primary caregivers in in-depth efforts to understand their motivations and perceptions about early childhood media exposure, I set forth the praxis between the professional recommendations and their actual lived experiences with technology and young children. Building on these insights, I present a conceptual framework for research which considers the dyadic use of technology due to the close relationship between primary caregivers and young children. Based on the various roles of technology in international student mothers' parenting, I present implications for designing technologies which can assist parents in their care giving duties.

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(GENERAL AUDIENCE ABSTRACT)

Digital technologies such as televisions, touch screen tablets, smartphones, and smart speakers are now frequently encountered and used by young children even before the age of one, and facilitate modern parents in their caregiving of young children due to their prevalence in the home environment. The use of these devices is especially common by international student mothers of young children who subscribe to a multiplicity of roles such as being a productive student, efficient mother, and dutiful partner in a new country. I employ autoethnographic and participatory asset-based approaches to involve these mothers as equal stakeholders and collaborators to have an in-depth understanding of their technology use context. I explore the various gratifications sought by caregivers and children through their uses of technology, and illustrate how current technologies succeed in delivering those gratifications, and where they encounter failures due to their unique living circumstances. By engaging primary caregivers in in-depth efforts to understand their motivations and perceptions about early childhood media exposure, I set forth the praxis between professional recommendations and the lived experiences of caregivers with technology and young children. Building on these insights, I present a conceptual framework for research which considers the dyadic use of technology by primary caregivers and young children due to their close relationship. Based on the various roles of technology in international student mothers' lives, I then present implications for designing technologies including screen-based digital childcare assistants and interactive shows, conversational user interfaces as bilingual language learning partners, and mobile applications to support young children's incidental learning, which can assist parents in their care giving duties.

Dedication

To Izzah, my muse, the most lovely, caring, and funniest little girl, the one who
transformed me, and made this dissertation possible;
To Haisum, the one who believes in me, encourages me to dream bigger, facilitates me to
achieve my goals, and brings out the best in me;
To my future children and grandchildren, the generation that I strive to inspire by being
ambitious.

Acknowledgments

As I make my way towards the final steps of my doctoral studies, I must acknowledge the prayers, efforts, and support of everyone who made this work possible.

I will forever be grateful to my beloved parents, Bashir Ahmed Bhatti and Feroza Bhatti, who nurtured me with love, and blessed me with constant wishes for my success. Whatever I have been able to achieve in life, I owe it to their sacrifices, love and prayers. I thank Allah everyday for the opportunity to be under the umbrella of their love and prayers.

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Contents

x

List of Figures

List of Tables

Chapter 1

Introduction

Defining technology   In this dissertation, the meaning of the term *technology* refers to digital devices frequently used by young children. Key among these technologies are screen and voice based devices such as televisions, touch screen tablets, smartphones, and smart speakers, which are frequently encountered by young children even before the age of one [183]. These technologies also appear in the literature as mobile media [67, 192], digital media devices [127], digital technology [61, 192], and screen media devices [168]. These technologies provide access to screen- and voice-based media content suitable for children, which is often selected and curated by adult caregivers. Since the devices, and the media delivered and hosted on these devices do not function without one another, in the context of this dissertation I consider them one and the same.

I chose to focus on this technology because of its prevalence in domestic life, where parents and caregivers reach for them in order to simply 'get things done', including accomplishing duties from housework to meal preparation to basic personal hygiene [213]. Caregivers in the recent past have been more receptive to children's use of these technologies when they found themselves in circumstances where they had to be confined at home with children for extended periods of time, and where these devices aided them in performing a variety of family-oriented and child-oriented activities [24, 147].

Due to caregivers' supervisory role as the gatekeeper of young children's media consumption and use of technology, children are often dependent on their preferences and motives

when it comes to determining allowable technology access and the curation of media content [119, 174]. Therefore, it is important to consider caregivers' motives and preferences regarding technology based on various factors including (but not limited to) circumstantial needs, personal characteristics, work/life balance, and cultural influences.

One subset of caregivers are international student mothers, who are often primarily responsible for the majority of childcare and domestic duties [21, 148, 181], and hold authority on decisions around their children's technology usage as the primary caregiver [174]. These mothers hail from countries with continuing traditional understandings of parenting roles and responsibilities, subjecting them typically to more cultural responsibilities and stigma regarding their parenting practices than fathers [24], which is why they influence a greater number of technological decisions concerning their young children. The juxtaposition of cultural differences, gender-based disparities in responsibilities and opportunities, and the struggle to juggle between contemporaneous responsibilities of being a mother and a graduate student, may have repercussions on their attitudes and practices concerning technology use. Their unique circumstances, responsibilities and values [86], make it important to study their motivations from various perspectives in order to understand their technological choices concerning their young children while parenting in the United States (US). Hence, the general term *mothers* used in this dissertation will refer to the user population of international student mothers of young children in the US.

1.1   Motivation

My investigation of the daily practices and perceptions surrounding the use of technology by international student mothers and young children is inspired by my own experience of moving to a new country and experiencing childbirth and motherhood, while also pur-

suing higher education with no support structure (family or close friends) in the US. My choice of studying the experiences of international student mothers in the US is also motivated by the fact that the US is the global leading host country of international students [11, 197, 201], with a 44 % (678,841) share of non-immigrant students in the 2018 calendar year being female [115]. Their education is supported by scholarships, assistantships, grants, loans, and personal funds [153], which means that they often then live in financially tight circumstances. Prior literature show that many mothers in academia pay the *baby penalty*[1] [142], as the cost of availing of childcare in the US is not affordable for many student parents [40, 60, 176, 191]. Hence it is important to empathize and design parenting technologies for the well-being of this population to ensure lower drop-out rates and to give them broad opportunities and choices with regards to expanding their families.

1.2 Research Statement

I investigate the role of digital technologies in the lives of international student mothers of young children in the United States (US) with two primary foci: the identification of gratifications sought by such mothers by their children's use of this technology, and the implications for the design and research of digital childcare technologies that can fulfil those gratifications. I navigate this problem domain by using a participatory research approach in leveraging the self-described assets possessed by the student mothers such as their academic writing skills, tacit knowledge, and resilience. Through this work, I conceptualize technologies that can facilitate international student parenting, and can be useful tools for the caregiving of young children in general, and also share research insights for engaging caregivers as resourceful participants.

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[1]a term coined by sociologists who argue that in the workplace, working mothers encounter biological and cultural based disadvantages in pay, perceived competence, and benefits relative to childless women.

1.3   Research Questions

While establishing the importance of this user population in my research, I encountered their strengths which could be leveraged in my own exploration by promoting a greater level of engagement from them, as captured in a series of research questions (RQs). This begins with the first research question where I ask **RQ1: How can we effectively engage mothers in research as resourceful participants?** While trying to answer this question, the focus is on 'engagement', instead of eliciting 'needs', hence the studies investigating this question are designed to identify and leverage mothers' motivation to participate in research.

The second research question addressed in my dissertation is: **RQ2: What are the different uses of, and gratifications sought from children's use of technology?**. This involves exploring the popular choices in terms of technologies preferred by caregivers and children, the prominent gratifications sought through the use of those technologies, and the context of use of technologies in parenting. Each of these explorations is answered by the following sub-questions:

- *RQ2 a: What gratifications are sought by international student mothers through their children's use of technologies?*

- *RQ2 b: What gratifications are sought by caregivers through their children's use of technologies?*

By discussing the various roles of technology in mothers lives, and cross referencing it with insights gained from answering research question 1 and 2, I then ask **RQ3: What is the transferable learning for the research and design of technologies for parents and young children?**
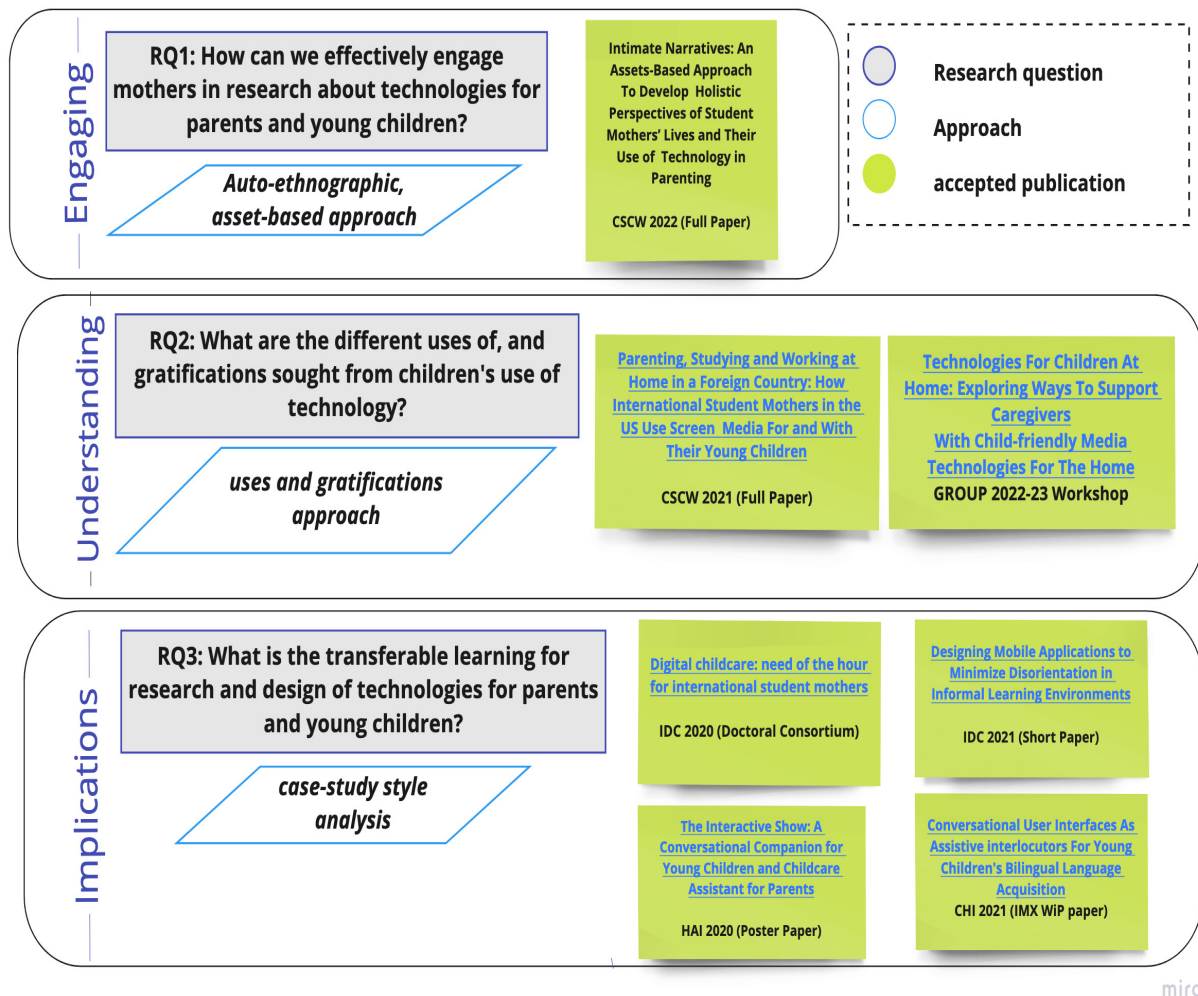
Figure 1.1: A visual representation of the connectedness of the three core questions guiding the research in the dissertation, with their anticipated outcomes fulfilled by the work outlined in publications and presentations at various academic conferences

Figure 1.1 provides a summary of my dissertation work, its connectedness to the subquestions that represent the three core components of the dissertation, and the contributions of each individual research effort. Individual research efforts which comprise this dissertation are listed in table 1.1.

1.4   Dissertation Overview

This dissertation comprises six chapters, including an introduction chapter, background chapter (2), the methods used and adapted during my dissertation research (3), an exploration of the gratifications sought by caregivers through the use of technology by young children (4), a discussion of the findings (5), and a conclusion chapter (6). A short description of each of the remaining six chapters is as follows:

1.4.1   Chapter 2: Review of prior literature

Chapter 2 builds the case for research on international student mothers of young children in the US by outlining the related research and how this dissertation research builds on that work. It also bounds the scope of this dissertation by defining the study population and the focus on young children. It concludes by describing the theoretical underpinnings of the studies which constitute this dissertation.

1.4.2   Chapter 3: Answering research question 1

Chapter 3 attempts to answer *RQ 1* by introducing ways to approach the research of technology use by parents and children at home by engaging in research leveraging their unique capabilities. Building on lessons learned through subjectification, it defines a study where I engage international graduate student mothers as empowered collaborators to narrate their intimate biographical stories. Rather than focusing on improving or redesigning technologies, this work centers the nuanced complexities of motherhood while juggling work responsibilities, cultural differences, and the competing pressures of child-raising and academia.

1.4.3 Chapter 4: Answering research question 2

Chapter 4, based on the insights from the intimate narratives described in 3 which details the prominence of screen-based devices in mothers' parenting, attempts to answer *RQ 2* by describing an initial investigation of the role of screen based technology in international student mothers' parenting by investigating the context of use based on their background and lived experience, the gratifications they seek from their children's exposure to screen media, and their perception about the use of screen media by their children as educated, foreign mothers. It also describes the conceptualization and fulfilment of a virtual meeting of caregivers and researchers in the domain of child-computer interaction in an attempt to expand participation beyond the intended user group. Together, the group explored this design space by engaging their personal and professional personas to initiate conversations about young children's use of technologies at home, critiques of current research practices in this domain, and other novel ways to communicate and interact with emerging technologies in the home. In doing so, they proposed a path forward facilitating the design of technology and media, and policies about their use by young children.

1.4.4 Chapter 5: Answering research question 3

Chapter 5 considers findings from 3 and 4, and cross-verifies them with prior literature to answer *RQ 3* by highlighting the various roles in which technology facilitates international student parenting, and the opportunities that exist within this space to design technologies for parents of young children.

1.4.5 Chapter 6: Conclusion and future work

Chapter 6 concludes this dissertation by discussing key findings and the anticipated impact of this dissertation work. It also describes the immediate and long-term research agenda stemming from the work completed in this dissertation.

RQ(s)	Research effort	Method	Sample	Contribution
1	Tailored probes for investigating use of technology at home	Subjectification	n=1	Design and customization of probes in the domestic setting
1	Asset based approach for a holistic perspective of technology use	Collaborative auto ethnography	n=4	-Adaptations of assets-based methodology in an intimate setting -Holistic understanding of participants and their technology use context
2	Mother-child's dyadic use of screen based technologies at home	Interviews	n=12	Implications for design of technology to facilitate parenting at home
2	Technologies for children at home	Virtual ideation and brainstorming	n=18	Building of community of caregivers and researchers working the domain of parent-child computer interaction
3	The interactive show	Ideation	n=3	Defining key features of the interactive show: understanding, responsiveness and maintaining an uninterrupted conversation flow
3	Technology as caregiving assistant for parents of young children	Personas and scenarios	n=3	Implications for practice for digital childcare assistants:
3	Designing educational mobile apps for informal learning environments	Observations	n=44	Affordances of parent-child use of technologies for learning in informal learning environments
3	Assistive interlocutors for bilingual young children	Interviews and ideation	n=12	Design orientations for technologies for bilingual language learning

Table 1.1: Summary of my dissertation work, its connectedness to the sub-questions that represent three core components of the dissertation, and contributions of each individual research effort

Chapter 2

Background and Related Work

2.1 Dissertation scope

Studies show that new parents can experience social isolation and loneliness because of the full-time responsibilities of taking care of a baby [85]. Student parents in particular experience conflicting identities, where they strive to balance the time-sensitive demands of their distinct identities of being both students and parents [80]. Student parents who pursue graduate studies in the US may also be affected by variables such as financial difficulty, language barriers, and being cultural outsiders [24, 152, 224]. While in some countries childcare responsibilities are shared by grandparents and other non-working family members [175], the burden of childcare in the US rests on the international student parent(s) as they usually do not have the luxury of having family living close by. Research also shows that female graduate student parents are reported to be twice as likely to quit academia compared to their male counterparts, due in part to the lack of 'clock-pausing'[1] permissions in their academic careers [141, 142]. These significant life changes can result in a crisis of self-identity [31], where the student mothers may question life choices including becoming a mother, pursuing higher education, or moving away from their familiar support structures.

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[1]postponing an academic or career milestone for a certain period of time

2.1.1   Primary caregiver: International student mothers in the US

An important subset of these parents is international student mothers, who may face added challenges in moving to a different country to pursue higher education and adjusting to unfamiliar environments while caring for their young children as a (possibly primary) caregiver [24, 136, 165]. While research on women's work-life balance positions them as being privileged in being able to choose between work and motherhood [175], there is growing evidence of how technology is increasingly blurring the boundaries between women's work and domestic life as caregivers of young children [154, 199], where their schedules are more closely tied around that of their children in comparison with their (primarily) male partners. Childcare practices that are mimetic and passed down through families are often difficult to adopt for these mothers when they are raising children in a country with a significantly different culture from their homeland [209]. Foreign student mothers often adapt (or even feel pressured to adapt) childcare practices that may be very unfamiliar to their family members at home, mainly because of the major shift towards a lifestyle balancing studies and work [209]. These practices may include using digital media and screens as a short-term solution for engaging children [21, 24] or working from home in the wake of the recent COVID-19 pandemic. The juxtaposition of cultural differences, gender-based disparities in responsibilities and opportunities, and the struggle to juggle between contemporaneous responsibilities of being a mother and a graduate student, may have repercussions on their attitudes and practices concerning technology.

Research on women's work-life balance while striving to maintain their mental well-being [151, 175, 199] tends to focus on one primary aspect of their identity: as a mother, as a graduate student, or as a foreign student. In my research, I look at the intersection of in-

ternational student mothers' attitudes towards technology and their context of technology use as a parenting tool by understanding their motivations, cultural backgrounds, and lived experiences as foreign graduate student mothers of young children.

2.1.2   Focus on young children

Since the developmental milestones for young children vary greatly [162], I further narrow my research focus on parents of children between the ages of one to four years, as this pre-kindergarten/grade school age is most likely to require some form of parental supervision in the absence of professional care [98]. Parents and preschool teachers state that children in this age range often know more about technology than they (parents and preschool teachers) do [173]. These children are also starting to become more independent, with a greater focus on objects and people around them while they explore and make sense of their surroundings [166, 167].

2.1.3   Other caregivers

Although the main focus of my dissertation is on the student mother-child dyad as primary stakeholders, within the context of the domestic environment and the local milieu, I recognise the need to investigate the co-use of technology by other caregivers such as fathers or grandparents with young children to give a holistic view of the family practices around technology usage. To that end, the two studies described in chapter 4 give (an albeit partial) picture of fathers' technology use with young children, where mothers describe their contributions towards caring for the children. I also include perspectives of fathers in intimate narratives described in chapter 3, where fathers participated as passive participants in the research. Finally, the workshop activities reported in chapter 3 include

preferences and views of various caregivers and researchers to provide a broader representation of caregivers.

2.2 Related work

2.2.1 Technology and parenting

Technology plays a vital role in facilitating the caregiving practices of modern parents [135], where parents use technology to find support online [8, 172, 194], entertain and distract children inside the home through digital media devices [10, 46, 61, 67, 138, 182], and to engage children outdoors [26, 145]. Domestic HCI studies thoughtfully examine co-use of screen media technology by mothers and young children by studying the use of mobile media by children and their families [61, 67], young children's use of tablets [109] and television [188], the role of technology in supporting communication practices among parents and young children [138], regulation on technology use instituted by parents [106], and parental mediation strategies and perceptions about early childhood media exposure [131, 192]. These studies tend to focus on the use of a particular kind of screen media device, or include a broader age range of children, which is different from the family dynamic I am exploring. Lauricella and colleagues examine the factors influencing children's screen-time and parental attitudes around a broader range of screen media devices frequently encountered and used by children in the home, reporting that children's screen-time usage is strongly associated with parental attitudes and their own screen time [127]. I build on their work by further investigating the gratifications sought by mothers in my study population through their children's use of technology on a conscious and unconscious level, which may influence their attitudes around the use of those devices.

2.2.2   Motherhood and HCI

Women (cisgender or trans) may experience life transitions such as pregnancy and child-birth due to their distinct biological factors, which can affect their physical and mental wellness [177]. These unique experiences come with a range of emotional and social pressures, which are distinct from fathers [185]. Current research in HCI focuses on many aspects of motherhood [12] including the use of technology by mothers to increase their confidence, reassurance on their choices and concerns regarding their child, and as a means of self-therapy and as a community builder [91]. Technology has also been used by mothers for information seeking [172], sharing information about their children [149], creating and participating in ICTs due to lack of formal support systems [31], support without judgement [194], or to simply stay connected with the world [138]. There is also a special focus in HCI on the experiences of first time mothers and women in early stages of motherhood, specifically their use of digital media for information seeking during [155, 179] and after [134, 179] the transition to motherhood. Often, the technologies for mothers imply moral platitude, ignoring the subtleties in attitudes and feelings of mothers [64]. I use these studies as a benchmark to understand this under-studied community of mothers, and to provide recommendations for technology while being considerate of mother's attitudinal nuances.

2.2.3   Role of adults in design for and with children

The seminal work of Allison Druin nearly two decades ago defines four main roles children can play in the process of designing technology for them [70]. This work laid the foundation of defining the different roles children play based on researcher's goals for inquiry with children, the stages where children get involved in the design process, and different rela-
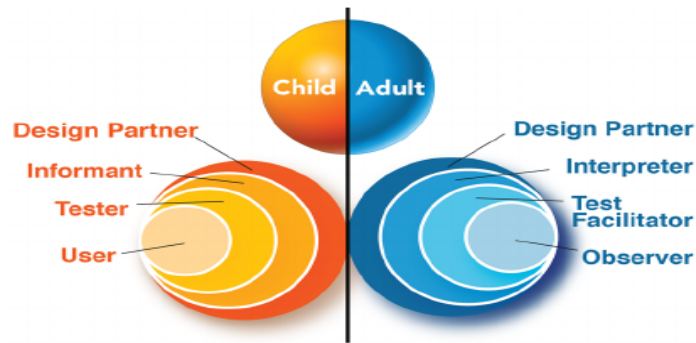
Figure 2.1: Roles of children [70] as defined by Druin and the corresponding roles of adults in designing children's technologies.[225]

tionships of adults with children [70]. Although prior research suggests roles that children may have in the design of technology [70, 95], most of it is focused on the roles of children aged four and above. Figure 2.1 describes the corresponding role of adults with respect to children in the design of children's technologies, where the engagement of children and adults is represented with a sphere during the design process [225]. In their respective roles, adults may participate in design on children's behalf (proxy), encourage children to participate (motivators), look after children (caregivers), clarify children's ideas (facilitators), scaffold children's ideas and thoughts (scaffolders), and generate ideas and co-design with children (design partners) [20]. In the context of my dissertation, young children (aged between one - four years old) relied on their caregivers as interpreter of their needs. It has also been noted that adult participants are more privileged, knowledgeable, and influential in comparison to the children [150]. However, as the focus of this dissertation is on engaging adult caregivers in research, I explore the power dynamic between the primary and secondary caregivers while determining and mediating technology access, and between the designers and policy makers of children's technologies.

2.3   Theoretical underpinnings

2.3.1   Uses and gratifications of technology

Uses and gratifications theory is used by researchers to understand the motive behind the preference for a certain type of media over the other, providing cues for understanding how people seek, consume, and are affected by their choice of content [125]. The approach presumes users as active seekers of gratifications from their media use [195]. Gratifications are the diverse dimensions of user satisfaction [104] provided by, and obtained from different kind of media and motivating consumers to utilize certain media [146]. Communications research has approached the study of children's media use through the uses and gratifications perspective [54, 188], and the use of screens to assist parents in their parenting tasks has also been reported in social sciences and family studies [76]. In my review of research on the crossroads of HCI and uses and gratifications approach, previous work has not examined the uses and gratifications of technology use by mothers of young children in the domestic sphere to the best of my knowledge. Qiao and Zhu describe the limitations of current research in HCI due to the lack of focus on newer, richer media choices and the neglect of consumer's personalized preferences and behaviours which can impact their uses and motivations behind certain media use [180]. My research seeks to fill this gap by focusing on the motives and selection patterns of technology and media by mothers in the context of their lived experience. I further explore whether they are able to successfully attain their sought gratifications, and what, if any, are the gratifications obtained inadvertently by their use of technologies. The uses and gratifications of media are also influenced by several factors such as the socioeconomic context of the family and ages of children [15]. Therefore, to get a well-rounded view of the role of technology in mothers' lives, I ground my research in uses and gratifications theory to investigate three aspects of

their use: a) complexities and challenges of adapting to the multiple roles of parent, student, and spouse in the home, which could explain their technology use context in parenting, b) the gratifications they seek from their children's use and the extent to which state of the art technologies are able to provide those gratifications to explore opportunities for design and, c) their perceptions around their children's use of technology with their unique positioning as high-literate, culturally diverse foreign mothers.

2.3.2 Collaborative asset-based approach

Participatory research and design involves users and stakeholders in various stages of research, while benefiting from their involvement in different roles and degrees of participation [72]. Participants' engagement with research for longer periods of time is dependent on various factors, including the researchers' understanding and the research subjects' concerns [111], empowerment through participant strengths, and the use of reflexive and flexible strategies to position them as 'co-researchers' [72]. Engaging in co-design sessions requires the establishment of trust and acceptance between research participants, and between participants and the researchers[53, 217]. Work in this realm explores various roles that can be adopted by researchers, including advocate, facilitator, ambassador, or activist [28, 72, 110, 130], to ensure a greater level of participation from stakeholders. During such participatory research efforts, design researchers may share their personal identities, relevant experiences [204], and relatable aspects of their researcher identities [6] to establish trust and enhance participants' acceptance of the researcher as an authentic member of the community [72, 204]. In doing so, the researcher may take on multiple roles including community ambassador, liaison, and facilitator in addition to their primary role [204]. Throughout this engagement process, consideration needs to be given to the issue of retaining the engagement of stakeholders through a balanced distribution of power between

researchers [129].

Numerous research scholars in HCI have proposed asset-based design [87, 220, 221] as an efficient approach for creating lasting impact, as opposed to needs-centring design, arguing that the latter perpetuates existing stereotypes and results in design for the 'here and now' [221]. Instead, such scholars argue for the importance of employing users strengths and capacities at the core of any design process for sustained research impact. In my exploration of the situated use of technology by mothers with their young children, I build on work which employs an assets-based approach to recognize and built upon the mothers' inherent strengths and capabilities, as opposed to their needs, weaknesses, and limitations. [89].

Chapter 3

Autoethnographic lessons from the home
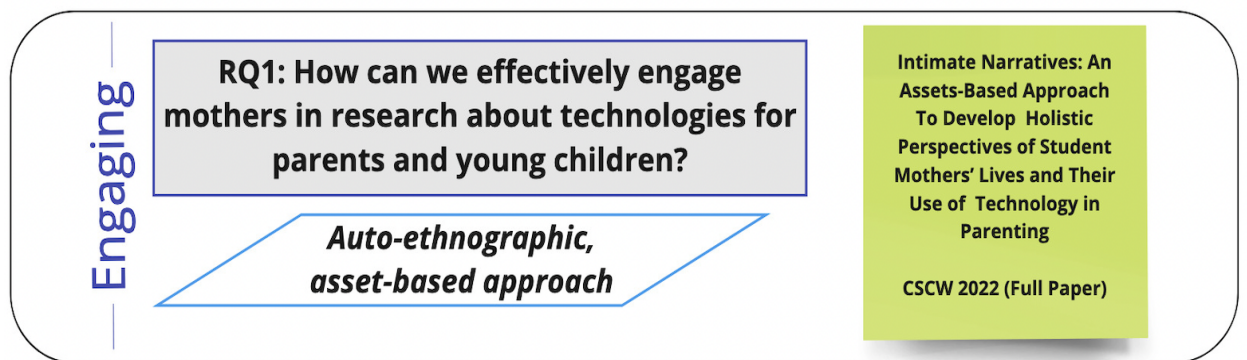
Figure 3.1: Chapter 3 introduces ways to approach the research of technology use by parents and children at home by engaging mothers leveraging their unique capabilities.

In the words of Jerome Bruner "if you look at how people actually live their lives, they do a lot of things that prevent their seeing the narrative structures that characterize their lives. Mostly, they don't look, don't pause to look" [34].

3.1 Introduction

Common methods of research used to understand contemporary parenting with technology at home include observation of participants' behaviours and practices in their naturalistic

settings, interviews, surveys, diary studies, and co-design sessions with stakeholders. These methods, while effective in engaging large groups of stakeholders [105], tend to focus on practices and attitudes concerning technology and in doing so, may not provide particularly rich or context-specific insights about users themselves. Moreover, they often do not include direct interpretive input from the studied participants to validate if the findings indeed authentically portray their lived experiences as shared with observers [17]. In some cases, researchers may not be not fully aware of the specific dynamics of the technology usage environment [160], which can lead to the development of data gathering methods that elicit generic and/or superficial data. Such approaches tend also to focus primarily on existing patterns of technology use, with the aimed intention to develop more/better technological solutions for the target participant group [72]. Researchers adopting these methods often approach study groups as *friendly outsiders* [93], asking what participants need and suggesting solutions to meet those needs. However, such approaches may neglect or even erode the participants' sense of agency and control in the research activity, by focusing solely on the 'here and now' of the context of technology use [221]. These approaches may not reveal an authentic biographical understanding of *participants' identities* that could influence their attitudes and motivations for technology use.

Recent research supports the development of pragmatic approaches for data gathering in domestic environments with greater levels of participation from users [56, 113, 114]. For investigating a sensitive setting such as the home, researchers encourage involvement of the user as an active member of research, instead of being a "docile victim and passive recipient" of design [56]. In this chapter, I build on these recommendations by first describing my lived experience with technology with an autoethnographic study of self-designing data collection probes, and then collaborating with student mothers to facilitate the autoethnographic narration of their experiences with technology in their parenting.

3.2 Subjectification

In HCI, the term 'probes' has become an umbrella term covering various forms of investigation instruments from diaries to longitudinal user studies [29]. The probes have been used extensively to supplement traditional research methods over the years, tailored according to people's personal settings and personal contexts [35]. Despite their effectiveness in producing engagement with the participants and encouraging design provocations, critiques of the probes approach to design have also termed them as inadequate substitutes of qualitative analysis methods of everyday practices [68] such as ethnography, interviews or observations. However, probes are a suitable method for sparking reflection in this study due to the impracticality of other ethnographic methods such as self-interviews or self-observations as it is an autoethnographic account of probe use. In this study, I explored the role of technology in my own life as a pilot study. As an international student mother of a young child, I assumed the role of *provocateur* to investigate and report on the findings from self-designing and using probes by adapting them to my domestic environment and family dynamics. The two questions guiding this research with respect to the aims described included: *"What is the role of screen media in a student mothers domestic life, and how can we use this knowledge to their benefit?.*

3.2.1 Study design

With the use of probes, I attempted to understand three dimensions of a mother's perspective of the technology in their lives: in relation to their children, to themselves, and to their partners. I named the first probe as *Uses and gratifications*, as it explored the gratifications I sought from my child's everyday use of technology, and whether I was able to obtain the gratifications I originally sought at the end of the day. It was also aimed at ex-

ploring the context and use of screen media by my child throughout the day. The second probe was called *Ambivalence Canvas*, aimed at understanding whether a reflective activity could identify the most prominent apprehensions of a mother regarding her child's technology usage. The third probe was named *Screen time chat*, as the use of this probe aimed at serving as a conversation starter for the partners regarding the child-rearing practices with the use of technology. The probes were designed as a combination of empathy [108] and domestic [90, 96] probes, by creating a space for the user to explore their thoughts and actions by giving them something to do in their home environment. I leveraged the design properties described by Wallace et. al in their framework [216] to guide the probe design. Although they describe the third property of the time and effort required to complete a task as *pace and challenge*, Derix and Leong describe them as separate but related properties, which are affected by different design decisions [62]. Hence I utilized these four as distinct properties to guide my design decisions. In addition to these, I included two properties of *motivations* and *characters* to describe the expected outcomes by the use of each probe, and the people involved in their use. Each property from the probe design framework [216] was tailored to suit the user's number of children, everyday routine as a student mother, and family dynamics. The probes were used for a period of seven days, to gain insights into the routine over the weekdays and weekend. It is important to note that some of the design decisions were tweaked after the first day, due to their incompleteness or unsuitability due to their context of use.

3.2.2   Insights

The most salient gratifications I sought from the use of screen-based technology was distraction, followed by engagement and learning good behaviour (Figure 3.2). These three gratifications were sought and obtained each day, with an addition of entertainment when

I wanted to restrict the child's use of screen-based technology, but the child wanted to use it regardless. The most common uses of technology were as a means of distraction while I got ready for work and school, prepared and ate meals, or studied. The choice of seeking and using technology as a distraction or engagement tool depended a lot on the *context of use*, which seemed to be a missing piece of information while noting the uses and gratifications.

For the most part, I felt guilty for my own use of technology instead of the child's use, especially in the child's absence (while she was at daycare), since I noted being engulfed by the feeling of sacrificing my time by indulging with entertainment or connection with family through screen media for extended periods of time. There were times when I felt hesitant writing what exactly I was feeling bad about, because I did not want to put it on record for the world to see, knowing that it was not something culturally appropriate to be done by mothers of young children. In addition, I had to struggle about noting a negative feeling or ambivalent thoughts during the weekend, as I was busier than the weekdays, and also felt generally happy about life. For expression of my parenting regrets or ambivalent thoughts, I found out that my preferred medium of expression was only text.

While the screen time chat initially probed my partner and I to be more conscious about how much screen time we allowed, the conversations took a different turn in a few days when they became comparative. At one point we engaged in a conversation about who plays more with the child, and who just hands devices to her during our respective supervision. This brought our roles as parents, student, employee and homemaker in the conversation, each justifying and weighing on the amount of work we had to do. In the final days of probe use, the activity became overwhelming where we actually avoided the conversation. As parents, we struggled to complete the activity by coming up with a number, with my partner just agreeing with whatever I said that the child's total screen time was. The

visibility of the notes did not help much either, as we became indifferent to their presence on the wall in a few days as we crossed them several times each day, without stopping to review them.
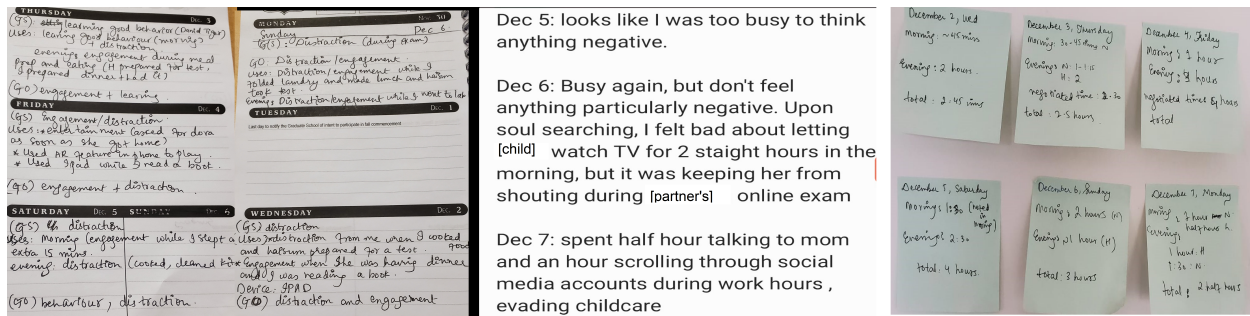
Figure 3.2: Left: Planner entries for gratifications sought versus gratifications obtained during the course of the week, Middle: Notes on the Ambivalence Canvas, Right:Negotiation pointers for screen time chat

3.2.3 Discussion

Subjectification

The subjectification and tailoring of the probes according to family dynamics and routines uncovered findings which would have otherwise gone unnoticed if the probe design was generic. In the Uses and gratifications probe, I found that the uses of technology were not always steered by my will or circumstances, but also by my child's mood. Hence, the gratifications that I sought from the use of technology were partially influenced by my child's choices. Findings from using the Ambivalence Canvas were not consistent with my initial hunch of feeling bad as a parent every single day, as there were days when I actually had to put some effort to surface a guilt, regret, or negative feeling as it did not naturally exist. Additionally, most of the ambivalent feelings were about my own use of screen media devices instead of my child's. Finally the screen time chat probe did not have the affect

on our routine as envisioned. While it helped the parents converse, the conversations were often short, deliberate, and comparative.

Takeaway: Although the self-design of probes comes with certain anticipation about the results, the insights are often different from designers preconceived thoughts. It is mainly because of factors such as the characters involved, time of use, and how concealed feelings come into play after probe deployment and use.

Designing for self: too much or too little?

Being involved in the design of the probes allowed me to tinker with the design properties, for surfacing the insights of and around screen media use most efficiently. I added two additional properties to guide and ground the design and use of the probes by keeping the family dynamics in mind. It also allowed me to amend some data gathering techniques such as audio recording the negotiations about screen time with my partner to mainly keep a record of my thoughts, which also helped in recording unexpected turns of conversation. Some design decisions were even challenged by my own time constraints and feelings, such as using only text to convey the ambivalent feelings about parenting. While I initially thought that the liberty to express myself in any medium would produce richer insights, the simplicity (and familiarity of the medium due to being in academia) of text made it the most convenient mode of expression for me. Another design decision of noting the child's screen time after putting them to bed turned out to be inefficient due to the fact that I sometimes fell asleep with my child, which had to be adjusted by having discussions right before the child's bedtime. I also started adding contextual information about the use of screen media to produce a holistic picture of the uses and gratifications of screen media as a parenting tool.

Takeaway: Self-designing the probes helps in tailoring the probes according to family dynamics and the context of deployment, maximizing the insights gained from the probe use. The liberty of tweaking the design as and when it is needed also helps in utilizing the probes in an efficient manner.

3.2.4   Conclusion

The findings from this study revealed sensitivities of the domestic environment which need to be accounted for in research to avoid unforeseen circumstances and chances of elevating tension between family members. I found opportunities in expanding the user participation by giving them greater control over the requirement gathering and evaluation of their technological experiences. I argue that this increased level of participation provides richer insights into user experiences, as the probes are designed and adapted according to the individual user or family unit.

3.3   Collaborative autoethnographic approach

In this study, I transitioned from autoethnography to group engagement in order to capture a holistic understanding of parental technology use. Based on the findings from the previous study, I approached and worked with mothers as collaborators and co-authors[1].

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[1]A version of this study has been accepted to appear in the Proceedings of the 25th ACM Conference on Computer-Supported Cooperative Work and Social Computing

3.3.1 Introduction

In highly personal contexts—such as understanding parents' attitudes and motivations towards using digital technology in the home—we need to capture a holistic perspective of parents' previous experiences and present values and practices. It also necessitates greater and continued involvement of participants in various stages of research for their personal experiences to be accurately portrayed and in a respectful way [124]. Recent research of relevance to these personal contexts proposes an asset-based approach, where the focus is on participants' strengths and capabilities which can be leveraged during investigations [89, 220, 222]. By empowering participants to share their experiences using the strengths available to them, researchers can engage them in the design process within a space of comfort and control [38]. In this work, I employ this approach to produce a biographical understanding of a particular subset of parents, that of foreign graduate students who are mothers of young children, which situates their use of technology within the realities of their lives.

The prerequisite of developing that holistic understanding is to nurture a safe space fostering mutual trust and understanding among research participants and researchers. Work in this realm explores various roles that can be adopted by researchers, including advocate, facilitator, ambassador, or activist [28, 72, 110, 130], to ensure a greater level of participation from stakeholders. During such participatory research efforts, design researchers may share their personal identities, relevant experiences [204], and relatable aspects of their researcher identities [6] to establish trust and enhance participants' acceptance of the researcher as an authentic member of the community [72, 204]. In doing so, the researcher may take on multiple roles including community ambassador, liaison, and facilitator in addition to their primary role [204].

Similarly, the collaborators in this research participated by taking on the roles of researche, facilitator-researcher, and AG member (detailed in section 3.3.1). The role of *researcher* draws from the concept of communities of practice, where experienced members of a community assume a position of responsibility, and are expected to initially perform at higher levels of expertise than other members [128]. Based on similar work where belonging to a community helped researchers to build upon an existing shared rapport with participants [106, 130, 204, 224], I *facilitated* the research process between participating mothers and other members of the research team. While all of the researchers planned and executed the work, I had a natural affinity with foreign graduate student mothers, and our shared circumstances fostered a certain level of trust among us, enabling the AG members to comfortably narrate their sensitive narratives. In doing so, I assumed the role of a researcher as well as a member of the group, as opposed to being merely a friendly outsider. Together, the foreign graduate student mothers and I formed an *affinity group (AG)* with shared circumstances, assets, motivations, and research goals [214]. Through reflection cues and writing scaffolds, researchers supported the AG members in describing their practices and interactions related to children and technology at home, allowing their stories to emerge organically over time. Although I use the term 'participating mothers' or 'participants' in this study, as co-authors, the AG members were collaborators in the research, rather than research subjects. Except for section C, which has unaltered stories penned by the AG members, the remainder of the paper is a collaborative effort from all authors who owned the research while assuming a position of shared responsibility [129]. Thus 'participation' implies their involvement in the research as much as that of facilitator-researcher and other researchers. For readability purposes, I use the terms 'I', 'we' and 'our' in this paper when referring to the researchers (including the facilitator).

In my work, I define assets as the unique strengths possessed by the collaborators. The

AG's self-described assets included their academic writing skills, tacit knowledge, and resilience. While they were not necessarily experts in this paper's domain of research, they were expert parents and graduate students, whose scholarly experience as graduate students made them valuable contributors to different aspects of my own explorations, instead of being simply research subjects. Inspired by Cunningham and Mathie [57], I also tried to understand what motivates the AG members to share sensitive and intimate details about their parenting with technology, which could drive their continued participation and personal involvement in this research. The researchers helped the AG members identify and utilize these existing, but often unrecognized assets, through narratives[2], by describing how they acquired them. It is worth noting that the AG members are graduate students who are experienced at writing academic articles. Their writing skills were an asset available to them, which was leveraged in this research. However, academic writing is structured and closely follows norms established within the domain of study. In this research, writing was an asset but the personal and intimate nature of writing meant that the AG members were engaged in a relatively familiar yet still removed or strange activity. This may have helped the AG members to move beyond mechanistic writing and to thoughtfully reflect on their lives and parenting practices. The remaining three researchers/co-authors brought their experiences and knowledge about asset-based approaches, participatory research, feminist HCI, and design methods in HCI to the research activity. Thus, the co-authors came together with their unique assets to make this research endeavour possible.

In the subsequent sections, I describe the efforts in engaging the AG members by leveraging their unique strengths in research, and ensuring their privacy and comfort levels when eliciting intimate narratives about their lives as foreign student mothers of young children.

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[2]I use the terms *narratives* and *stories* interchangeably due to their similar meaning in the context of this research.

Enabled by the focus on their unique strengths, researchers assisted the AG members to present a sensitive, personal, and deeply felt view of their experiences with technology. Although this research was primarily conducted during the COVID-19 pandemic, the intimate narratives cover various aspects of the AG members' struggles as foreign graduate student mothers, while surfacing also the role of technology in different stages of their lives. While the individual narratives are presented as snippets of the everyday lives of foreign PhD student mothers, when read together as a whole, they give much more contextual information about the choices and technologies used by mothers and young children, providing an holistic and longitudinal view of their lives. I reflect upon the approach of creating an affinity group, fostering a safe space for engagement in research, and the implications of using our adapted research methodology in intimate settings. I conclude by highlighting the expansive ways in which technology facilitates foreign student parenting, and the ways in which it serves as a temporary band-aid solution prompting consideration of larger social issues.

Contributions

The primary contribution to the HCI and CSCW literature with this work is to present the adaptations of assets-based methodology in an intimate setting, focusing on engaging participants by expanding on their distinctive assets to present deeply personal narratives. I discuss what it means for researchers to care for the participants in a self-reflexive way, and discuss transferable learning from this work to inform research in a sensitive setting. I adopt this stance both to add to a growing body of CSCW scholarship focused on working with communities in diverse contexts, and to encourage participants from various backgrounds and identities to engage in similar enforcing efforts to provide more visibility for their experiences.

A secondary contribution of this work is demonstrating what it means to apply this methodology in a sensitive and highly personal context. I present intimate and personally meaningful narratives which provide insights into the lived experiences of the foreign student mothers' lives, bringing socio-cultural aspects of their lived experience to the forefront, and situating their use of technology in the broader context of their lives.

Positionality and Reflexivity

The AG members   The four AG members in this research, who are also co-authors in the accepted CSCW paper, had diverse parenting experiences but were unified by their identity as foreign student mothers raising young children in the US. At the time of writing, four of the AG members had partners who were also enrolled in graduate programs. Two of the AG members had lived in the US without their children for a time ranging from 6 months to a year, as they focused on their education while their children stayed back in their country of origin. To protect their identities, we use the first four letters of the alphabet as pseudonyms in quoting their experiences. *A* is a second-year PhD student living with her young child with a long-distance partner who currently resides in their home country. *B* is a fourth-year PhD researcher, whose partner is pursuing a Masters degree in the US. He is also working a full-time job to provide for their family back home, and feels he cannot dedicate as much time to childcare as her. *C* is a third-year PhD researcher who moved to the US for graduate studies, and lives with her child who is on the autism spectrum, while her partner is pursuing a graduate degree in another state in the US. *D* is finishing her degree in an interdisciplinary field and is struggling to obtain adequate resources to complete her dissertation. After separating from her husband, she currently finds support through her partner in the US and a very supportive mentor.

The researchers   While I had a personal commitment to complete this research project, I was mindful that the self-reported experiences may have some level of bias due to the AG's deep emotional attachment to the narratives. I collaborated with a team of researchers who, from one standpoint, are distant from specific inter-sectional conditions that foreign student mothers of young children face but, from an intellectual and social orientation, care about the population and the challenges they face. One of the researchers is a mother of two young children and previously experienced life as a foreign graduate in the US. Two other researchers are male, one of whom was an international graduate student until recently, while the other is an involved father of three children. As feminist HCI researchers, all the members of the research team engage in centering human values and fostering care-centered futures. In this regard, the research team is seen to be in close periphery to the AG.

3.3.2   Related Work

I reviewed the literature to define the research scope, and to develop a research strategy to enable the collaborators to use their existing abilities and strengths while examining their lived experiences.

Equal and Empowered Participation

Historically, participatory design (PD) was concerned with workers having input into the introduction and use of technology in the workplace [13, 28, 75]. As technology encounters expanded beyond the workplace, PD approaches evolved to involve people in the design process across diverse contexts [75, 196]. While the participants' roles and their degree of participation may vary, the central belief of people having agency and voice in being

involved in matters of concern to their lived experience can be seen across diverse PD approaches (e.g., [18, 72, 88, 219]).

PD scholarship highlights various factors and configurations in involving participants in matters of concern to them [3, 28, 58, 72, 111, 120, 130, 196]. Broadly, we find two interrelated factors influencing the degree of participation. First, the need to establish trust and acceptance between research participants, and between participants and the researchers [53, 217]. This necessitates that researchers play various roles [130], sharing relevant experiences [204] and relatable aspects of their identities [6] to establish trust and enhance participants' acceptance of the researcher(s) as a member of the community [72, 204].

The second factor influencing the degree of participation is the extent to which the participants' agency is supported during the engagement [13, 18, 88]. Indeed, there is an interesting tension here: participation can support participants' sense of agency, but participants' agency is critical in enabling participation. In this space, scholars argue that in some cases where design focuses on users' needs, it positions the users as dependents, eroding their agency and resulting in design for the 'here and now' [221]. In response, they propose assets-based design which involves leveraging and building upon the resources and strengths that are already available to the participants [65, 89, 122, 169, 220]. The focus on assets can enable participants to have greater power and agency in their participation [89, 222]. Furthermore, assets have been defined as "those strengths, attributes, and resources that can be brought into relevance to satisfy the inherent tensions between a member of a population's needs, their understood or experienced aspirations, and the structural limitations of the system" [87, pp. 9]. By bringing the AG members' existing assets to the fore, we sought to support the participants in experiencing a sense of confidence, comfort and control while they shared and reflected on sensitive narratives about their lives.

In this space, Wong-Villacrés et al. [222] posit three methodological commitments in conducting assets-based design: building trust with and among the participants, forming a collective, and engaging in incremental reflection together. We align with these values. In particular, to build trust and mutuality, I became part of the AG and sought to actively involve the AG members throughout the research journey. Our configuration of the research setting supported the development of trust among the AG members and the researchers, fostering a space where participants could share personal perspectives of their lives as foreign students who are mothers of young children. Furthermore, in our exploration of the situated use of technology by the AG with their young children, we tap into the AG's self-identified existing assets, most notably their writing and storytelling skills, to create a space that enabled them to feel empowered to share intimate details and to be vulnerable with one another.

Rich and In-depth Narratives

Research about the use of technology has challenges, such as obtaining insights about users' everyday lives and routines due to a lack of trust between researchers and users, inadequate methods of data collection and inquiry due to designers' unfamiliarity with the context of use, and possible reluctance of participants to be observed by an outsider [96, 159]. While research about designing technology in the domestic space has endeavored to actively include users during the entire design cycle [105], its focus is still on how new technology is embedded in users' lives instead of targeting the holistic understanding of users themselves. This broader understanding includes exploring various dimensions of participants identities, such as their attitudes and motivations towards using technology formed by their past experiences, and what value they perceive as a participant in the research. We strive to explore these dimensions of the AG's intersectional identities through

autoethnographic narratives about their past and present experiences. These sensitive narratives are written with 'affect', unfolding experiences that can be 'funny, perturbing or traumatic', that 'do not await definition, classification or rationalization before they exert palpable pressures' [202]. We moved away from arriving at a definite, correct, and meaningful conclusion [17], rather focusing on utilizing their potential as student researchers through participatory engagements.

Our choice of using narrative inquiry as a method of elicitation was motivated by its effectiveness in conducting intercultural research focusing on understanding the lived experiences of people through their own stories [48, 49, 164]. It can be useful for engaging diverse groups of individuals in understanding their experiences within a wider social context [92]. It prioritizes the holistic understanding of the AG members' situated lived experiences through autobiographical, exploratory, and open-ended narratives [207]. To elicit these intimate narratives, we built upon Kotut et al's work in navigating technology design spaces by understanding and involving the community of use [124]. We used their work to understand the sensibilities of handling community stories while revealing diverse uses of technology, which can co-exist within the AG's traditional and modern parenting practices.

3.3.3   Methodology: An asset based approach in an intimate setting

By adopting an asset-based approach, we wanted the AG members to 'speak for themselves' [4] through their autoethnographic narratives while abstaining from being in a position of authority or direction. While this approach aimed to produce a meaningful autoethnographic [77] account of their lives to evoke empathy and compassion for people liv-

ing in similar circumstances, we did not want to directly pose leading questions. Rather, our approach attempted to slow down the process of evaluative critique and representational thinking to give room to a contact zone of analysis [48, 202]. We wanted to present the narratives as they were conceived and written, and pivot from analyzing them, (for example by using grounded theory), pivoting instead towards adopting a reflective stance on the complexities uncovered during the discussion sessions. Instead of referring to the AG member's experiences as *findings*, we refer to them as *'intimate narratives'*, in an attempt to respectfully position them as being beyond 'data'. Through these narratives, we attempt to slowly valorize the AG's tacit knowledge without decontextualizing, quantifying, or explicitly defining it [200]. This allowed the AG members to describe their vulnerabilities through intimate narratives about their lived experiences with technology, thereby strengthening their representation in the academic body of work to which they regularly contribute, but often not as subjects and co-researchers [72].

Ensuring Privacy and Comfort

The researchers' efforts at creating a safe space for collaborators included concealing all identifying information such as the AG members' current ages, home country of origin, program of specialization, and ages and names of their children and spouses, from the narratives, which could potentially be linked with their author information. To avoid any occurrences where the AG's narratives could be associated with them due to explicit mention of their child's gender, we requested all AG members to refer to their children using masculine pronouns in their stories, which also differentiates from the feminine pronouns they chose to use for themselves. This did not alter the facts and events in their narratives. By doing so, we wanted to protect their personal and professional identity while being respectful towards their stories. The narratives contained vulnerable snippets of the AG mem-

bers' personal lives that could be prone to scrutiny by potential readers and collaborators. Considering that as a possible hindrance to being candid about sharing their experiences, we tried to create a safe space by asking co-authors to submit their narratives to me (as a facilitator-researcher). I embedded the narratives in a text document after anonymizing the content. To ensure further assurance, our collaborative writing space was shared with the researchers only when the AG members had jointly edited the document. I also tried to maintain transparency and visibility by iteratively sharing pointers for review and discussion by the AG [17]. During the entire research process, the researchers and the remaining three AG members did not communicate directly at any stage. The AG members were made fully aware that once published, their personal narratives may become vulnerable to scrutiny by the readers [78], but having their personal narratives guarded through anonymity allowed the AG to share, without risking their professional and personal identities [110].

Ethics

Prior to beginning our work, we contacted the Institutional Review Board (IRB) at our university for human subjects research determination, and the board informed us that our proposed research " appears to not be human subjects research, but would instead be considered to be oral histories". Thus, our study was conducted without IRB oversight. Our approach mirrors the collaboration between the co-authors in Devendorf et al. [63], where the studied participants are also co-authors on the manuscript, exempting them from IRB review as their narratives are self-reflexive and auto-biographic. It is worth noting here that the AG members were made clear of their rights to drop participation at any point without any penalty and, as mentioned above, we prioritized ensuring that they were comfortable and had control over their participation. To this end, we also sought to involve

them throughout the research journey, including in collecting the narratives, synthesizing
the narratives, and finally, presenting the narratives to the public as a research article.

Collaboration Process

Our collaborative process is comprised of three stages with varying types and levels of in-
volvement from the authors of this paper (figure 3.3).
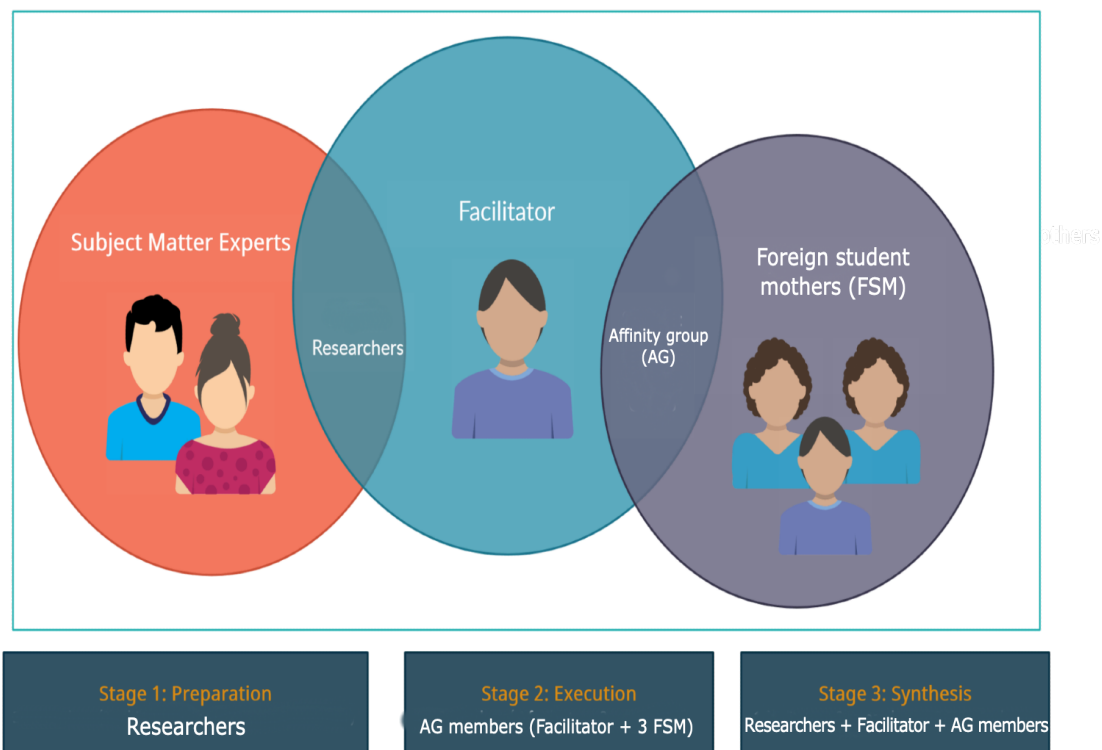
Figure 3.3: Collaborative process between the team of researchers and foreign student
mothers. It is comprised of three stages with varying types and levels of involvement from
the researchers, facilitator-researcher and AG members

Research Formulation   The first stage brought together the researchers to define the research scope, formulate the research methods, and determine the roles each author would play. After reviewing the relevant literature (detailed in 3.3.2), we limited the research scope to understanding technology use and the lived experiences of international student mothers of young children. Specifically, we sought to focus on mothers who had a more recent experience of pregnancy, childbirth, and moving to a new country for higher education compared to mothers of older children, which could make it hard for them to recall those events in their lives more clearly. Considering that student mothers of young children already have significant responsibilities, we decided to commence the identification of collaborators and the collection of narratives during the US summer months, when the AG would potentially have a break from their regular courses and some graduate research/teaching assistant duties.

In approaching potential collaborators for this research effort, a formal invitation for collaboration (listed in Appendix B) was developed and iteratively revised by the researchers. I assumed the three roles of researcher, facilitator-researcher and AG member, and was responsible for identifying, approaching, and recruiting AG members. Potential collaborators were identified through my interaction with women in academia (n=2) who were also mothers, through various professional activities (online courses taken together, professional workshops), through acquaintances and participants from a previous study (n=2), and through mothers' publicly available information on Twitter (n=8). In distinguishing student mothers of young children in the US, I traversed their publicly listed bios and tweets to ascertain their current country of residence, children's age, and occupation. In cases of ambiguity about the country of residence, I searched their username to see if it connected to their professional profiles. This search was aided by popular twitter hashtags (e.g. *#AcademicChatter, #PhDLife, #PhDChat*) and user profiles (e.g. *@Momademia,*

@mothersinsci) tagged by these mothers in their tweets.

We heard back from nine out of twelve potential collaborators. After further examination of participant fit, we ultimately limited our collaboration to three members (other than the facilitator-researcher) in the interest of gaining depth and richness into their experiences [63, 64]. With a broad range of experiences, our AG members formed a fairly diverse group of foreign student mothers. As a group of two Asian and two African mothers, the AG members were from diverse backgrounds (originating from three different countries), with varying parenting experiences (two co-parenting young children, while two of them were solo parenting as their partners lived in another US state/home country for studies or work). One of them was a mother of a child with special needs, and two of them had experienced living away from their young children for a period of six months to a year while they adjusted to their life in their new country.

Collaborating mothers met (virtually) three times in the span of three months (each meeting lasted about half an hour). As the timeline for submitting vignettes was very flexible, we could not estimate the total number of hours the authors put into completing them. The AG member's involvement in the research was voluntary, and they were allowed to leave the research endeavor any time and for any reason. We offered them a $50 gift card for as a token of gratitude, and an option to be a co-author in the publication. After the commencement of research, we felt that $50 may not have been an suitable compensation, so we reached out to the co-authors again, asking them what they think would have been an appropriate compensation for their time. All three collaborating authors stated their reasons of participation in this research to be beyond monetary compensation. One of them said and I quote (with their permission):

> *"I didn't see the amount actually as a payment for the time spent in writing be-*

> *cause I would have still done it even without the payment. Some of the reasons why I joined in the research is because the research work presented a very interesting topic which is of interest to me and also, the opportunity to co-author in a research paper which is important to us as a PhD student."*

Collecting Narratives During the the second stage, each AG member had a one-on-one virtual briefing session with me, where I described the motivation, goals, and likely outcomes of the research project; the minimum expectations from them for participation as a co-author; and a flexible timeline for meetings and writing contributions. During these individual meetings with each member, I also gave an anonymous introduction of the remaining AG members to build a certain level of familiarity among the co-authors without them directly meeting each other.

To provide a writing scaffold, I narrated my own story by writing vignettes (three-five sentences) [203] that loosely answered the reflection cues detailed in the appendix (e.g. B). For each reflection cue, they were requested to write about two to three vignettes describing their experience. Compared to studies where participants narrate their personal stories in first-person singular pronouns [164], the AG members were asked to use pseudonyms to differentiate between their subject and writer identities in their narratives [202]. Pseudonyms were also used to protect their personal and professional identities while also promoting forthright candidness and deep authentic engagement with the research. The AG members were provided with an option to choose the writing platform that they were most familiar with, and all of them chose to complete their individual narratives using Microsoft Word. Initially, all of them worked on their narratives independently, and emailed their collection of narratives to me as a text document within two weeks of receiving the reflection cues.

Three weeks after the initial individual meeting with AG members, I emailed the AG members the collective draft of the narratives as an editable Google document (for ease of collaboration) for them to review, and invited them to identify anything that made them feel uncomfortable or they believed was inconsistent with their intent. In the same email, I also asked them to submit some short paragraphs describing their felt motivation for partaking in this research project, any distinguishing or prominent life facts about their experiences (to include in the positionality and reflexivity section), and their overall vision of technology for parents and young children. They were also requested to provide a suitable time for a second meeting to discuss their thoughts about the ongoing research, or provide feedback about the paper draft.

Despite having a choice of maintaining their anonymity, the AG members showed interest in meeting as a group after reading the collective narratives. During the second meeting (roughly a month after recruitment), all of them felt comfortable having a synchronous video chat with the other AG members (figure 3.4), where their identities were not concealed (similar to the study by Mankoff et al. [137]). The first draft of anonymized intimate narratives was agreed upon as ready for researchers' review during this meeting. Although this meeting was initiated as a collective discussion, the AG members spent most of the time becoming acquainted with one other and sharing anecdotes of their lives as foreign student parents in the US. To ensure privacy, we did not quote those private and intimate conversations anywhere in the paper.

Synthesizing Narratives   In the final stage, I facilitated the discussion and review sessions to reflect on key commonalities between the narratives, and to consider the strengths and limitations of the adapted methodology. During the first session, researchers (including the facilitator-researcher) read and extensively discussed the anonymized narratives

Figure 3.4: AG meeting, where first author facilitated the discussion sessions. All of them felt comfortable having a synchronous video chat with the other AG members after reading collective narratives, but their faces are concealed in the publication.

to order them chronologically. We found an overlap between the AG member's formation of multiple identities before and after coming to the US. As such, technology use was found to be more prevalent in their life after coming to the US, as opposed to the moment in time when they decided to have children, or pursue higher studies outside their home country. The representative intimate narratives are presented in section 3.3.4 for brevity, while the remaining (equally important) narratives are collected in appendix C.

During the third (and final) online synchronous meeting, the AG members reflected on the commonalities within the narratives, and provided further clarifications to the facilitator-researcher about insights which stood out for the researchers. Finally, the research team reflected on the strengths and the limitations of the adapted methodology. Sections 3.3.5 and 3.3.6 report outcomes of these two sessions. After each session, the facilitator-researcher invited the AG members to review and discuss the grouped narratives, and to provide feedback about how they viewed them with respect to the narration of their stories. With each iteration, the AG reviewed the manuscript in its entirety to identify any inconsistencies in the narrative. The AG members were particularly asked to read through the draft

to scrutinize and identify points of information that they felt uncomfortable sharing, examine if their stories sustained their essence after anonymization, and remove redundant pieces of information. This was done to encourage dialogue about potential misinterpretation by the researchers, and to carefully mitigate any potential harm caused by any power differences between the people involved in this research [111, 121].

3.3.4   Intimate Narratives

Instead of referring to the AG member's experiences as findings, we refer to them as 'intimate narratives', in an attempt to respectfully position them as being beyond data. The narratives in this section are organized in the form of vignettes, which allow the reader to connect with and gain insight into their lives [64, 203]. Each vignette is titled to provide a summary statement of the section in a playful and meaningful way. These narratives are presented as they were written and co-constructed, correcting only for minor grammatical fixes and the agreed upon removal of redundant text. Vignettes are briefly prefaced with introductory text to maintain the transition into the next narrative.

We start with an intimate narrative that gives context to the AG's choice for having children and moving to the US for graduate studies. As these major choices made by the AG make them different from others, we consider them important in understanding their motivation for forging a new life.

> **Parenthood or student-hood?:**   C was of age by her cultural norms to
> be a wife and mother, yet she struggled with the dreams of being a graduate
> student. The role of a woman in a developing country is more about keeping
> a home than anything else; a woman who does otherwise is an exception to
> the rule. She wanted to be an exception, and luck smiled on her when a friend

from way back decided to be her partner while offering the promise of helping
her to fulfil her dreams. During their courtship, they decided to hold on to ex-
tending their family to focus on the process of acquiring higher degree in the
US, but life happened. Immediately after the wedding, she discovered she was
pregnant.

The AG members described the role of their partner during their transition through multi-
ple life-altering experiences in a short span of time. For the AG members who were accom-
panied by their partners to the US, the process of moving and adjusting to a new country,
while carrying out their responsibilities as a graduate student and mother, took a toll on
their relationships, surfacing tensions between the partners [80].

The 'Power Couple':   Her baby was two months old when her husband left
home, as he could not cope with the system of the country, inadequate power
supply, and poor internet. His profession demanded the use of technology and
access to proper facilities, and as a young couple they argued about finding a
balance between meeting deadlines and attending to a crying baby. Truth was,
both were very ambitious individuals; friends had tagged them 'the power cou-
ple' because they always spoke highly of their dreams. To support their life
goals, he encouraged her to apply to schools in the US since this was where he
intended to pursue his career. While studying for the tests required for study-
ing in the US on her computer, she often sat with her son latched onto her
breast.

The AG members narrated their hesitation as well as motivation in using technology as
a parenting assistant while caring for their young children. For children born in the US,

technology served as a means to bridge the geographical distance between children and their remote loved ones:

> **Oh, I know these people:** Born in a foreign land without family around, B's baby recognized family only as a face on the smartphone screen. It was definitely not an ideal introduction, but they wanted to acquaint him with close relatives including grandparents, uncles and aunts, and cousins. He did not seem to be as interested in the humans on the screen as he was for the cartoons, but that changed when they visited their home country six months after the baby was born. It was like having a 3D view of the 2D people he had been seeing all this time. When they were back in the US, the baby seemed more interested in hearing and engaging with the relatives back home, slowly starting to identify them according to their respective relationships as he grew older.

Screen-based technologies such as iPads and smartphones also helped two of the AG members communicate with their children who were living with their grandparents, while they tried to settle into their life in the new country:

> **Siri with a conscience:** Grandparents had gotten the baby an iPad when he was two so that he could *FaceTime* with his mother whenever he wanted. They lived in an isolated community in the US and books and the iPad were ways to claw out of boredom. Kids YouTube were D's kid's go-to app, where *Peppa pig* and *Dora* in Spanish were his best friends. She often thought what would she call a small AI-driven app or robot that curated videos and materials for her child and had all the attributes of an imaginary friend? A *Siri* with a conscience.

The digital devices also aided one AG member's struggles as the only co-located parent of a child with special needs. The absence of her partner through her journey of adjustment in a new country brought out a new set of challenges, such as an unexpected diagnosis of her child with autism. She described her use of technology to soothe and engage her child during times with challenging behaviors:

Tech bug: C could not explain why her baby always tiptoed or why he would laugh hysterically, or the reason why his speech was not forthcoming like other kids his age. Her baby was two years old when the doctor diagnosed him with autism. She wondered what the implications of the diagnosis would be on her studies, as she was just getting by trying to understand the American educational system which was very different from that in her home country. She had a steep learning curve to rise to the demands of being a graduate student, and the diagnosis felt like a square peg in a round hole. However, her baby loved music since he was a newborn, as this was one of the things that kept him calm during his tantrums or behavioral patterns. When he got tired of his toy instruments very quickly, C turned to technology for help, and there was so much it could offer, from music videos to learning apps. The baby caught the tech bug easily and could spend two hours watching a music video while she utilized those hours to catch up on assignments. It turned out that the educational programs he watched improved his ability to identify things despite the diagnosis, but this limited her parenting time with him. She wished she could be more available to play along with him, but deadlines had to be met.

In other instances, the AG members used these devices to divert children's attention while they enjoyed some personal time to relieve physical and cognitive exhaustion, or snatched some intimate moments with their partners.

Television: the additional family member: B got a television (TV)
when her baby turned one, which was also the time when they were moving
to a slightly bigger apartment. What they initially bought as an entertainment
package for themselves somehow became a tool to distract the child, a child-
care proxy of sorts. Since she had no help at home, she often sought help from
the TV to engage her baby while she went to take a quick shower or prepared
meals in the kitchen. As soon as she turned on the TV, it quickly grabbed her
baby's attention, with the baby's state changing from 'distracting mama' to
'distracted from mama'. She even used it for having some breathing space to
check stories on Instagram and Facebook, or for replying to texts on *WhatsApp*
without being climbed over. When her husband came back home, they some-
times turned on the TV to talk to each other or have some intimate time to-
gether. In essence, the TV was that extra family member they sought to take
care of their child while they unwound for a brief period of time.

They also performed activities facilitated by technology to bond with their children, which
could enrich their communication with their children in the limited time they had:

Mother-child interaction: She began watching the baby's favorite shows
as the TV had been overtaken by his needs. She discovered a show that was
arts and crafts inclined and decided it would be a good way to participate in
his play. This turned out to be a great way to bond with the baby, making
cardboard pieces, painting, and using play dough. It did not limit his use of
technology as they explored new educational shows together. Her partner tried
to be a part of the play but sometimes it was difficult to make the connection
with the baby considering that the baby always preferred to be by himself.

Screen-based technologies were also used when children needed to be distracted outdoors:

Portable screens: A's baby got so used to her phone that she no longer has enough access to it. Not long after, the phone's screen had some cracks due to the poor handling by the child. Outside of the home, she used the smartphone to calm the baby in public spaces such as while eating in a restaurant when the cutlery was not enough to distract him, or during grocery trips when the baby would want to run around the store instead of sitting in the shopping cart. In church, smartphones came to her rescue to avoid him from running around the church. On long road trips, the smartphone was the baby's companion in the car seat, giving the parents enough time before getting to the next exit on the highway.

However, the AG members often felt that their choices of allowing more screen exposure than professionally recommended made them prone to judgment (or at least the perception of judgment) by family and friends:

Boon and bane: Being an only child who met or saw kids only when they went outside to run errands, it sometimes came as a surprise to people how B's baby remembered several rhymes and communicated what he wanted as a two-year-old, despite English being his second language which they did not speak at home. One time, while picking the baby up from a friend's place, the friend-parent commented on how the baby was excessively active and too chatty, followed by *"that must be because he watches a lot of TV as you are busy"*, the screen shaming too obvious to be hidden. Of course, her desperate circumstances lead her to adopt unwanted practices.

Despite the threat of possible screen-shaming, the AG members overall had a positive attitude about the potential impact of early childhood media exposure on their young children's learning:

Outsmarting: A's baby outsmarted most kids of his age, and spoke fluently with clear sentences, despite limited interaction with children at the church or while visiting a friend who has young children. When she decided to enroll him in childcare, the amazed teacher commented: *"I don't think your child needs any improvement in any area, he is very smart and has passed all the assessments".* She did not have time to teach her child, but the smartphone did the job well. Though screen exposure for kids is often criticized [1, 94], it seemed that technology's lap is the first school of a student parent's child.

As these narratives were written in an ongoing pandemic world, they also depicted life while navigating the challenges of COVID-19, where the AG members had to juggle their various identities of being graduate students and mothers in lockdown and at home with their young children.

Quarantine diaries: The pandemic hit right when D was a year away from graduation. Her baby was in the final quarter of pre-kindergarten and her husband had just completed his candidacy for a PhD, which meant that the bedroom had to be divided into work areas to accommodate online learning. What is this new world where she was a caretaker, mom, teacher, and, most importantly, a researcher looking to graduate? At least, she was lucky to have a partner who supported her dreams and goals as he suffered his own set of setbacks in the lab.

With COVID-19 bringing parents' predicaments to the forefront where they found themselves ineffective in regulating children's use of technology, their narratives advocate for giving credence to digital media devices for making parents' lives slightly easier in challenging times.

> **Clash of times:** Quarantine posed additional challenges for A as classes were online and graduate assistant duties had to be conducted via Zoom. While the baby enjoyed being near his mother every moment of the day, she used the tablet to distract the baby while she attended class. During one of the exams, she tried different measures to keep the baby restricted to another room to gain maximum concentration, but he preferred to use the tablet beside his mother. As a result, she set up her office meetings during her baby's sleeping time. This resulted in a state of a quandary as the professor preferred having a particular time for all of his teaching assistants, whereas she was bound by the baby's nap time to avoid disturbance.

In addition to the insights about technology, the AG members revealed the struggles of having more than one child, which in several circumstances led to the decision to hold off from having more children, despite their initial aspirations of having a larger family. Apart from the financial strain, the AG members reported experiencing discriminatory and inconsiderate treatment from advisors who had never been in their shoes (experienced childbirth and/or being a primary caretaker while in academia).

> **Summer skies:** D did not do well in her first semester because she was always late for morning classes and had to leave earlier in her evening class, reaching home exhausted after sitting on a bus for 2 hours. She had to confide in her graduate student advisor, who had also been a mother during her

post-graduate studies. It was like a match made in heaven to have an advisor who knew what it was like to be a mom and a student. Her advisor's recommendations came in handy as to where to find support, and her baby's daycare changed to an environment that was homely and subsidized by the state, this gave her some cash to save for the rainy day as her stipend had been spent entirely on rent and daycare costs. The major difficulty she faced was making time for her baby as assignments and submission deadlines began to pile up.

All in all, the AG members shared a holistic view of their experiences through these narratives, presenting them "to be read, critiqued, or ignored by the viewer" [64]. They revealed their stories of raising children contemporaneous with graduate studies in the US, described how various technological solutions facilitated their everyday life as a parent of young children, and shared their attitudes towards the use of technology as influenced by their past and present experience.

3.3.5   Discussion

Technology and Foreign Student Parenting

The intimate narratives present the AG's nuanced perspectives on the use of technology as a digital childcare assistant [21], where they rely on technology as a positive distraction tool, enabling the AG members to chart time and space to balance the multiple responsibilities that accompany their multiple identities. In essence, the in-depth narratives highlight various social and cultural forces that form the context for their use or rejection of technology. They further highlight the tensions and conflicts that they face in using digital technology, which can be perceived as being in conflict with "good" parenting practices. Despite the screen-time judgement faced by AG members, they had an overall positive

attitude towards using technology as a parenting assistant in the absence of help. While there exists a large body of work on how parents engage with and seek help from parenting communities online [8, 172, 194], these narratives tease the intricate space where parent-child interaction is facilitated through technology in the absence of online and offline communities of assistance.

The AG members described their vision of technology for their unique parenting challenges, which we communicate here as future research directions worthy of exploration by our fellow researchers and designers of media and technology for children. We note them as speculations about what might have worked as a better parenting aid based on the intimate narratives about their circumstances. Two out of the four AG members in this research were solo parenting their children while their partners were in another state or country, so they envisioned technologies that can effectively distract their children from their mothers when they attend to house chores or academic responsibilities. This was especially longed for during the pandemic, where children were present with their mothers during their working hours. Related to that, mothers also talked about having a mechanism to notify parents when young children indulge in physically dangerous behaviour while mothers complete tasks which require their undivided attention, such as attending a meeting or a class in another room. To make up for time spent mentally away from their children while they attend to their academic responsibilities, mothers talked about making educational programs centered on inclusive learning and effective parent-child communication that can help them bond with their children. As young children only watched videos or listened to music, one mother envisioned a small AI driven app or robot which could curate videos and materials for her child, ensuring that children consume age-appropriate content while parents are not co-watching. As members of a nuclear family with limited outside interactions due to the mother's busy schedules, AG members also desired interac-

tive content that could help build their children's social and communication skills. In that regard, one mother mentioned the possibility of encouraging physical activities in a social setting with other children enabled through technologies.

Prevalence of screen-based technology

It is interesting to note that while the general term 'technology' was used to examine how it facilitated or hindered the AG's parenting, their narratives predominantly referred to a subset of technologies (digital media devices) such as television, smartphones, and tablet devices. Curious about the non-appearance of popular forms of technologies for children such as baby monitors, gaming consoles, smart speakers and conversational agents [27, 69, 133], in the last video chat session, I asked the AG members about their experiences (if any) with these other kinds of technologies before and after coming to the US. Two AG members recounted their access to technology as being limited to laptops and smartphones in their home country, which they owned in their mid-twenties. The other two members had similar experiences, except that they did have access to broadcast television and portable cassette players and recorders in their childhood. Although there were other technologies they used after coming to the US (such as pre- and post-partum technologies including fertility tracker apps [82] and breast-pumps [66]), the AG members primarily utilized digital media devices with their young children for communication, entertainment, and deliberate distraction. This was also encouraged by the availability and affordability of these devices in the US as compared to their home country of origin [212]. As a member of geographically dispersed families, mothers found screen-based technology to better aid their communication needs as compared to non-screen devices, which did not retain children's attention for a long time when talking to remote family members. Consistent with findings from [24], AG members also described them as devices which helped them

get through parenting tasks by distracting, entertaining, or educating their child with little or minimal involvement on their part.

3.3.6   Reflecting on the Methodology

In the discussion that follows, I summarize the experience of eliciting intimate biographical narratives through an asset-based approach, and elaborate on how it can be applied in different sensitive settings by examining the constraints of the methodology.

Creating an Affinity Group

Compared to work that involves a facilitator as a non-member of the community [88], I built a respectful and intimate space as a researcher joining the AG. Contrary to work where the researchers have limited shared experiences [52], being a researcher as well as a member of the AG allowed me to be a representative of, and empathetic towards these different perspectives. The AG members expressed confidence and assurance in the research process due to my personal involvement as a facilitator-researcher, as I initiated the sharing of intimate narratives about my life with the other AG members. Their trust was strengthened by the fact that it was 'research beyond convenience' for me, which helped convey that the personally meaningful autoethnographic narratives would be handled thoughtfully and with care. While my position and identity may have enabled a degree of trust among the AG members, I believe that several decisions undertaken during the research were critical in this highly-personal space. Involving the AG members as co-authors ensured that their vulnerabilities were not presented in raw and unprocessed form, but rather cultivated and shaped with care by themselves and fellow AG members, allowing for a respectful representation of their experiences [77, 78, 124].

The approach of building trust by being involved as a member of the affinity group ended up fostering a deeper and continued bond between the AG members due to renewed understanding of their shared circumstances, providing avenues to learn about and be inspired by one another beyond our limited social media interactions. During the parting meeting, one member of the AG even commented on how this proved to be like a short internship during the summer, piquing her interest to explore HCI research and encouraging her to develop a research agenda in the near future. The AG members described feeling 'proud' of contributing to the research and saw this as an endeavor worth celebrating. Apart from the monetary and publication incentive, the AG members were keen to describe their stories to highlight their struggles that often go unnoticed. In a world where their merit is determined on different criteria – the number of children they have, their role in raising them, achieving academic milestones, and producing high-quality publications as a graduate student – the AG members looked at this engagement as an opportunity to define their vulnerabilities and strengths emerging from the amalgamation of these distinct identities. Consistent with work where participants found value in research engagement [32, 72] as research subjects that care [110], AG members were deeply interested in lending a voice to the travails of international student mothers, as they viewed taking part in this research as an opportunity to connect with an inner strength that had been hidden by societal and professional demands. Apart from the self-described strengths, the 'affinity' between AG members turned out to be an unanticipated asset in this research.

Fostering a Safe and Intimate Space for Research Engagement

The safe and intimate space in this research extended beyond the AG members' interaction with me. Members of the AG wrote and submitted stories at their own pace and from the comfort of their homes [32], which allowed them to reflect and engage with their

past experiences while co-existing with their young children and technology (and, at times, their partners). In this safe space, which did not temper their interiority or emotional experiences [110], they were able to write their stories from a position of control, without the presence of a 'third' entity such as researchers or facilitator-researcher probing them to elicit their narratives. This facilitated an in-depth engagement, allowing the AG members to reflect and engage with their lived experiences and share them in their own words, forming narratives that emerged naturally at a pace with which they were comfortable [34, 38, 92].

The reflection cues triggered traumatic memories or painful past experiences, which the AG members were not probed to share. Rather, they shared what they felt appropriate, encouraged by being a part of a close and caring community with shared experiences. Respecting their agency to describe their narratives helped in revealing their pleasant as well as uncomfortable experiences, which may have been omitted had we opted for traditional interview or focus group methods. Allowing the narratives to emerge at a natural pace helped in uncovering the AG members' unique circumstances that influenced their values around technology use in parenting. Importantly, their intimate narratives were not analyzed as data to derive implications for design [16] but were instead provided in their authentic form to inspire empathy and compassion. All of these strategies helped in developing trust between the AG members, enabling the space for them to open up about the most intimate details of their experiences, such as finding love, separation from their partner, going through miscarriages, raising children with special needs, and the different shades of their relationships with their spouse, academic advisors, and children.

Implications for Research in Sensitive Settings

This unique research endeavour in forming an affinity group for describing intimate experiences has some transferable learning for similar work in sensitive settings, such as working with vulnerable populations of incarcerated parents [198], parents who experienced loss of pregnancy [9] survivors of sexual abuse [9] or sex-trafficking [87, 89], or members of the lesbian, gay, bisexual and transgender (LGBTQ) population. I envision this work to be useful for CSCW researchers who want to engage deeply with communities, particularly in highly-personal contexts. They can encourage a greater level of involvement from members of such communities by incorporating the core principles of identifying and leveraging the unique assets of a user group, developing a safe and intimate space through researcher participation as a community member as opposed to being a 'friendly outsider' [101], and discovering what that population values in research to involve them as collaborators rather than research subjects. I demonstrate that these assets can be possessed by both researchers as well as collaborators, and effectively employing them in the research is imperative in surfacing in-depth insights about their technology usage context.

It is important to consider that I formulated this work as a research article for publication, and as part of that process, the article has gone through rounds of revisions. With each revision, I approached the collaborators to provide their thoughts on the feedback received, and to review the manuscript before the next submission to ensure that any changes or re-framing of the article arguments were consistent with their original authorial intent. While this proved to be a relatively easier task with a smaller number of collaborators, it might be difficult to engage and retain a sizable number of collaborators over a long period of time. Despite having a diverse group collaborators, I was mindful that this sample might not be representative of the whole foreign student parent population, thus as researchers, we also do not claim generalizability in terms of depicting the experiences of all

foreign student mothers. Additionally, the narratives describe the first-person experiences of cis-gender mothers who are primary caregivers of their young children. Researchers deliberately avoided scrutinizing the narratives to retain their essence and originality, and to refrain from negating the lived experiences of AG members. As a facilitator-researcher, I tried to limit the bias in the narratives through informal discussions about them in the meetings between AG members, but with stories being self-reports that could potentially free participants of socially sanctioned behaviours [139], cannot guarantee complete objectivity.

Despite the dissertation focus on international student mothers as the primary caregivers of young children, their narratives gave a preview of their partners' role (or sometimes lack thereof) in their life choices, childcare, and decisions relating to technology use. The mothers also played an unplanned role in communicating their partners' voice, occasionally providing their side of the story. As a possible next step encouraged by the interest shown by the partners of the members of this AG, I plan on inviting parents with different intersectional identities to utilize our approach of eliciting intimate narratives to give visibility to their stories of living with and using technology for and with their children. Future work in this research direction can explore other forms of media such as audio-visual narratives, self-designed probes by participants, or parent-facilitated elicitation of technology use from children.

3.3.7   Conclusion

Through a participatory asset-based approach, I engaged foreign graduate student mothers as empowered AG members to narrate their intimate biographical stories. I discovered opportunities in recognizing the mothers' value as student researchers due to their distinc-

tive positionality, as their scholarly experience as graduate students made them valuable collaborators in different aspects of research explorations, beyond just being research subjects. Rather than focusing on improving or redesigning technologies, this work centers the nuanced complexities of motherhood while juggling work responsibilities, cultural differences, and the competing pressures of child-raising and academia. The narratives contextualize mothers' use of technology for and with their children, while surfacing their challenges and vulnerabilities as a call for action for appropriate technologies to support their unique parenting circumstances.

Chapter 4

Uses and gratifications of children's technology
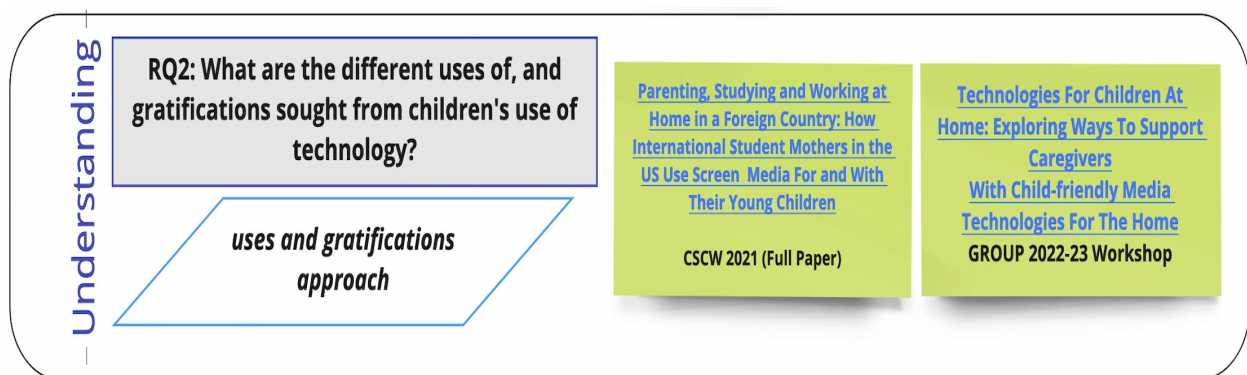
Figure 4.1: Chapter 4 defines the gratifications sought by parents and young children through their use of technologies.

Studies in chapter 3 unearthed the prevalence and importance of screen-based technologies in student mothers' lives. With the consumer market surge in screen media devices over the past decade [15], many mothers living without co-located extended family use them to engage their children while they complete their domestic and childcare duties. Their reliance on screen media devices as babysitters [45] is described as being due to the absence of daily caregiving help, limited options available for affordable and/or reliable childcare [59], as well as the cultural and social, and (sometimes) professional pressures and expectations placed on the mothers [59, 79, 80]. It prompted me to investigate the various gratifications sought by international student mothers through their children's use of screen-

based technology and media[1].

4.1 Uses and gratifications of screen-based technology

Screen media devices have gained a special status in modern parenting [46], where parents reach for the television, smartphones, or tablet devices in order to simply 'get things done', including duties from housework to meal preparation to basic personal hygiene [213]. During the COVID-19 global pandemic, these 'getting things done' activities may now also incorporate working from home under less-than-ideal conditions [158]. The advent of the 2020 international lock-down (due to the pandemic) coincided with the beginning of my investigation into the role of screen-based technologies in student mothers life, attempting to answer **RQ2 a: What gratifications are sought by international student mothers through their children's use of technologies?**. This overarching question is further divided into the following three sub-questions:

1. *What is the role of screen media in international student mothers' lives inside the home?*

2. *What gratifications are sought by international student mothers through their children's use of screen-based technologies?*

3. *How does their positioning as high-literate, non-US/foreign mothers affect screen media use by their children?*

By answering these questions, I draw attention to the context of use of screen media, which is affected by participants' socio-cultural backgrounds and their multitude of responsibili-

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[1]The subsequent details of the study design and findings from this investigation were published in the Proceedings of the 24th ACM Conference on Computer-Supported Cooperative Work and Social Computing.

ties. I discuss the various gratifications sought by mothers including the use of screen media for distraction/engagement, as a language facilitator, for incidental learning, for the maintenance of distant ties, and as a childcare proxy in the absence of co-located caregiving assistance with their young children.

4.1.1 Method

While observational methods in naturalistic environment are deemed crucial for child-family focused research due to their ability to reflect participants' behaviours and practices in their naturalistic setting, they also require highly trained researchers to avoid measurement problems [15]. As in similar studies [106, 224], my positioning as an international student and a mother was hoped to establish a shared rapport with the participants, allowing them to open up more comfortably during in-depth conversations providing a comprehensive account of their experiences (as opposed to surveys for example). The timing of this study also coincided with the start of the COVID–19 pandemic, which made interviews the most viable (and permissible by my university's review board) choice for studying the lived experience of the intended user group.

Being an international student and a mother, I was able to establish a shared rapport with the participants, which assisted in putting participants at ease—particularly when discussing challenging aspects of their lived experiences. While belonging to the user group helped me to empathize and be deeply involved in the experience shared by participants, it was also prone to introduce researcher bias. Hence, I collaborated with a group of researchers who, unlike me, had not experienced childbirth and motherhood as international graduate students. These researchers evaluated the findings as external auditors [59] to reduce researcher bias and to evaluate the findings from varied perspectives. To provide

context, two members on my research team were mothers of young children[2], four were international graduate students representing different genders, and two members were born and raised in the US[2].

Participants

I recruited participants using convenience sampling, snowball sampling, and by posting on university list services. Due to the timing of the study (the end of the semester), I did not hear back from a large number of students whom I approached personally and through word of mouth. 12 international students in the US who were mothers of children aged between six months to five years agreed to be part of this study. Participants were entered into a drawing for an Amazon Fire tablet for participating in the interview. The study had a representation of participants from the top four countries of origin for international students [73], with 11 participants from Asia (including Pakistan, India, China, South Korea, Saudi Arabia), and one from Africa (Ghana). Participants were members of six different higher education institutions in the US, with eight of them pursuing doctoral or post-doctoral studies. Participants were aged between 29 to 40 years (Mean=33, SD=3.6), and the majority of them (nine) had one child. While the majority of the participants had spent less than three and a half years in the US, three of the participants had lived there for a more extensive period, ranging from four and a half to seven years.

Data Collection

12 semi-structured interviews were conducted with participants between March and June 2020. Due to the COVID–19 pandemic and subsequent instructions from the institution's Institutional Review Board, I used teleconference software to administer the interviews.

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[2] Graduate student and Associate Professor

PID	Children's Ages
M1	5, 3.5, 2
M2	4, 1.5
M3	2
M4	6 months
M5	1.5
M6	2.5
M7	2
M8	1.5
M9	11 months
M10	4
M11	4
M12	2.5, 10 months

Table 4.1: Coded names of study participants aged between 29 to 40 years, with corresponding age(s) of their child(ren).*ages in years unless specified otherwise

The interviews were primarily conducted in English, with four exceptions, where the participants chose to speak with me in our shared non-English language. The interviews lasted between 23 minutes to one hour in duration (total 422 minutes) and were audio recorded with participants' permission. I then transcribed each of the interviews and translated four of the interviews into English.

Analysis

The anonymized transcripts were iteratively read multiple times individually by four other members of the research team who had not participated in the initial interviews, each of them producing a code list for every interview transcript. While I acknowledge that such an approach cannot fully mitigate any bias introduced into the original data set, I did want to achieve a somewhat more removed first level of analysis. I collected all codes from the individual transcripts, removed duplicates, and maintained a code book for all identified codes. In a joint session, all members of the research team sorted and identified

reoccurring codes, and labeled them according to the emerging thematic categories [30]. 73 emerging categories were then extensively discussed and grouped together in an online affinity diagramming session [86]. Three broad themes were found from the discussion corresponding to research question outlined in the introduction: 1) Parenting as an international student 2) gratifications sought from screen media 3) screen media use by children of educated, foreign mothers. I used these broad themes to group information about the mother's context of use based on their background and lived experience, their use of screen media use by and with their children, and the limitations of their experience to provide design recommendations. Excerpts from the interview transcripts were extracted to elaborate the findings.

Ethical Considerations

This study was reviewed by Virginia Tech's Institutional Review Board. Although the participants did not ask to remove or conceal any part of the interview, I found that our shared rapport made them casually communicate some sensitive information (quotes from their academic advisor, spouse etc.) which had the potential to be used against them. Inspired by Bruckman's work [33], I applied some level of disguise to their demographics by reporting participant ages and countries of origin as aggregate data, instead of individually identifiable information if combined with the ages of their children. This decision does not alter the findings from the interviews.

4.1.2 Findings

Parenting, studying, and working at home

Mothers described their diverse experiences as students and caregivers operating as single parents, temporary lone parents, or co-parents with other students. For example, M1 was the sole caretaker of her four children in the US, while her husband visited them occasionally due to the nature of his job back in his country of origin. She described the difficulty of balancing her cultural [181] and academic expectations, while also assuming the role of both parents in a country dramatically unlike her own. M10, who was raising her son as a single mother, talked about the challenges of dealing with his tantrums and maintaining discipline as a single parent who was also trying to complete her PhD. Participants whose partners were also students (M5, M7, M11), shared that in their experience, the burden of childcare was not distributed equally. M7 talked about how taking care of the child was a difficult task, and she could not depend on her husband as he had his own work to do. M11 initially thought her husband had an equal role in raising their daughter describing a time when she attended a seminar for a few days, while her husband looked after their daughter. As an afterthought, she added that she put more effort into their childcare duties due to the *two body problem*[3], where she deferred her career in favor of her partner. She wanted her husband to complete his degree sooner in order to get hold of a job, as he was on a student loan unlike herself (she was a scholarship recipient), and she did not want "his money to be wasted" while she completed her studies. For example, she stated:

> *"I cannot go to hangouts or any other things if my husband has a class. At*
> *times I have to skip my stuff because I have to get back home earlier to my*

---

[3]dual academic career couples, due to the increasing number of female PhD graduates and the tendency of women in academia to be partnered with another academic [210]

daughter [..] If my friends are going for any extra stuff like food or anything,

I never try to be a part of it, or I tell them that I have to be there with my

daughter as I can not leave her alone. Sometimes if there is an event at the

university, I take her (daughter) with me as my husband has a conflicting sched-

ule and nobody is home." (M11)

Seven of the participants were the primary full-time carers for their children in the home, meaning that their studying and research, together with housework and meal preparation, predominantly took place with their children co-present. This dilemma of having research demands occurring in conjunction with care-giving expectations also seemed to be compounded by the ways in which the participants compared themselves (often negatively) to other mothers (e.g. US mothers, stay-at-home mothers, mothers in their home country, etc.). M1 put this most directly when she stated: *"I think we suffer a lot, and we don't have support like other mothers here"*, while M10, when comparing her life to other mothers said:

"I feel one thing that I am not able to give him is more time like other parents

because I am studying [..] But I think I'm still doing my best during day time,

especially in lock-down, I just stay and play with him, and at night time I study

like, from 8 pm to 4 am." (M10)

M5, who was also married to another student, described how she felt disadvantaged whereby even though she had support from her partner, she perceived her daily experience as being more challenging than others:

"Sometimes I feel like their (other mothers) lives are easier than mine, as we

both (partners) are studying, so we have to manage stuff accordingly." (M5)

These descriptions serve to highlight the additional burdens and accompanying complicated feelings about work/life balance experienced by student mothers, which is further compounded by the extra acculturative, academic, and cognitive stressors experienced by international students in the US in general [5]. The student/carer expectations balance were even more starkly defined by M8 who talked about her choice of having only one child by quoting 'advice' from her academic advisor:

> *"One day my advisor called, he did not have an intention to insult me, but he told me 'please don't have another baby during your PhD', and I totally agree." (M8)*

The apparent conflation of childbearing with childcare responsibilities in this incidence is unfortunately common within academia [193], to the extent that it can also become socially internalized by mothers and fathers alike. However, it is somewhat improbable to imagine this advisor proffering similar advice to a male graduate student.

Lack of co-located familial support

The lack of a co-located familial or friend-support network was a major issue for the participants. This has been similarly reported in literature as a common phenomenon for new mothers [31]. However, it was different for these participants in the way that the support was not available to them due to geographical distance between their families, and the limited number of (if any) close friends in the US. One of the participants compared her life in the US to that of her home country of Ghana, stating:

> *"If I compare it with my home country, we are used to the extended family, when you give birth you have so many people coming in to help, but here we*

are all by ourselves doing everything." (M5)

Moving from childbirth to childcare, another mother recalled how people in her home country of Saudi Arabia had access to cheap and accessible childcare where they could employ full-time babysitters to live-in with the family in order to mind the children. Only five of the participants in this study indicated that their children attended daycare, with other participants specifying that the cost of daycare was prohibitive for their families. M8 and M12 described having their mothers or mothers-in-law visit them occasionally to help with childcare duties as both of the parents were students and did not have enough money to send their children to daycare. However, having an extended family member staying to help with childcare also brought its own set of problems:

> *"It is good to get help from family, my mother-in-law, but it also brings a lot of problems. My husband and I worked a lot for our relationship. Having a baby and raising a baby itself is very complicated, but dealing with another family member is 'one more big problem' and I needed to work on both, it wasn't that easy." (M8)*

The need for external support and the potential for conflict (particularly with regards to unsolicited advice) is noted in the literature which points to "mixed assessments of the net impact of a third generation upon new parent - grandparent relationships" [74], and in particular with parents over 26 years of age [51].

Screen-based devices as additional members of the family

Participants described using screen media devices with their children to communicate with distant family members, to engage in exercise and artistic activities, and to learn about

their families' cultural, spiritual, and religious beliefs. While many of the participants detailed how they often sought out and used devices simply as a way to distract their children while attempting to work, several participants also highlighted the important usefulness of screen media in assisting their children with speech delays or learning different languages. M7, who bought screen media devices specifically to engage her child, commented on how it ended up becoming an extended 'member' of the family:

> *"Previously we used to turn on the TV to entertain him, but now it's like the*
> *TV is a member of our family who keeps him engaged for some time while we*
> *do our work." (M7)*

As busy mothers in a nuclear family unit, the use of screen media devices by some participants occasionally resulted in conflict with their partners for using extended screen time as a distraction and/or for their assumed convenience. M7 described occasional technology 'score keeping' arguments with her partner, stating:

> *"We do argue about it sometimes saying to the other that 'you let him watch it*
> *for more time than I did' and 'why did you not play with him', so we do have*
> *quite a bit of conflict about it." (M7)*

M11's husband was concerned when she gave a smartphone to their daughter during mealtimes and attended to other tasks such as cleaning the kitchen. M6 described a different dynamic with her husband when he came home from a long day's work, even though she had previously described her unwillingness to expose her child to screens.

> *"Sometimes I don't want to show him any screen media but (husband name)*
> *comes home tired and says 'just let him watch it, let me have some peace as he*
> *(his son) is climbing over me, so let him watch it for a little more time'." (M6)*

Gratifications sought from screen media

Distraction/Engagement   Nine of out of twelve participants were culturally responsible/expected to cook meals for the family, and to be primary caregivers to the children. Hence, they often found themselves in situations where they had to divert their children's attention away from them to complete their assigned tasks seamlessly and quickly. Screen media devices and content became useful while performing tasks such as cooking, cleaning, and studying, often in the presence of children. Participants also used different screen media devices such as televisions, smartphones, and tablets as temporary distractions to enable them to complete household chores, put children to bed, or to keep children occupied while they finished their food [46, 47].

> *"I use the tablet mostly when he's eating, the tablet is placed on the dining table. It is a must when he's eating to prevent him from getting up and running out of his chair" (M6).*

M6 remarked upon her dependence on screen media by stating how her son would not let her work otherwise. M5 played songs or found something interesting on her mobile phone to show to her child. M2, whose children went to daycare pre-COVID-19, used the television to keep them occupied in order to complete her chores in the morning, including making breakfast and getting ready for school. She used technology as a convenience in the morning and for her children's entertainment in the afternoon (after they were back from daycare). Those distractions were short lived for children under the age of two, who had a relatively shorter attention span. M6 and M7's sons were very similar in age (two years), but had varying levels of engagement with screen media. M9's 11-month-old son needed her constant presence in order to be engaged in any activity. Similarly, while M6 found screen media to be efficient in engaging her child without her direct involvement, it

only lasted for a short while for M7's son:

> *"Once when I came home late from the lab, and I had not eaten my food, and*
> *he (son) wanted me to give him attention. So I told his therapist (who was tak-*
> *ing zoom sessions due to COVID) that I have yet to eat my meal, and she was*
> *like I am going to engage him for few minutes while you go and eat. It was*
> *only for a span of five minutes and he was not engaged during that time so*
> *eventually I had to get involved." (M7)*

It is worth noting that while many participants used technology to engage their children for a certain period of time, there was a fine line between the terms distraction and engagement in their descriptions of use. The participants used both terms interchangeably:

> *"Sometimes distract, sometimes engage. Like right now I'm working in the*
> *kitchen and he's watching TV, so I would say I would use the word distract*
> *right now. I also have to distract him from me when I'm studying. But to en-*
> *gage him when he eats as he does not eat if there's no screen in front of him."*
> *(M6)*

Unlike the negative connotation of the word distraction, this positive distraction often leads to engagement, helping participants in performing tasks which required their undivided attention.

Language facilitator   Most of the participants (except M1 and M10) were living in the US as a nuclear family, with their children getting minimal outside exposure due to their parents' busy schedules. Participants were also raising children who were multilingual, and several of them reported having minimal spoken communication in the presence of their

children, which resulted in some of the children having speech delays. M1 described her experience by comparing it with her sister-in-law who lived in a different country, but in a nuclear family set-up like her:

> *"She (daughter) has started sentences, but they're not too fluent, I have seen kids at her age who speak a lot, but maybe it runs in my husband's family in a way that my sister-in-law's son started speaking when he was four because they were living in a nuclear family in Saudi Arabia. Another reason is that we both don't speak a lot with her because we both are busy with the studies, so I feel she has also lagged behind because of that. Both of us being students was a challenge and we have had to cope with it. But because of that, I feel some of her development milestones were missed: not physically, but in terms of language and communication." (M11)*

M3 and M7, whose sons both had speech delays, utilized the interactivity offered by screen media in two different ways. M3 mentioned a children's show named *Blippi* in which a human character attracted children's attention by asking them questions. She noticed an improvement in her son's speech using rhymes as they encouraged him to learn new words, which motivated her to utilize her child's screen time for a word learning and recall activity that could be performed later. She claimed it was the fastest method to improve his speech compared to talking to parents, language therapists, or play-dates with other children. M7 scheduled meetings with her son's language therapist who had started giving sessions online owing to the COVID-19 pandemic, and used an app recommended by the therapist to help him to learn words. M7 also shared an anecdote about her son's attachment to his language therapist:

> *"The first time she came online, my son was not ready to see her, and was*

kind of upset, because he did not have an idea that she could come online like this. When I told her about it, she changed her background to 'wheels on the bus' screen, he saw that and quickly ran towards the screen. Normally our virtual session is half an hour, but it went on for an hour that day. He was enjoying it and not letting her go as she was really making him happy by responding to him and encouraging him to speak." (M7)

Some of the participants turned to screen media to help their children learn both their native language as well as English as a second language. One of the participants attributed her daughter's delayed speech to the fact that both parents were busy students. She then credited screen media for her child's improved speech and shared her experience on using technology to help her daughter with learning her native language:

"My husband puts on poems and verbal programs to get her more fluent with our native language. He has also installed an app "Urdu Seekhiye" (learn Urdu) on his phone which has all Urdu alphabet and words, so when she sits with him they can swipe along to learn them. She has learned vegetable names from it, so she goes and brings them from the fridge and kitchen cabinet when we ask her to use our language. It is kind of a play and pretend thing where she goes and comes back with the stuff that she has seen on the phone screen." (M11)

Incidental learning Being student parents, the mothers noted their investment in educational gains from screen media. They did not want their children's exposure to screens at an early age to go to waste and had an ulterior motive of letting their children learn something during their screen viewing sessions [107], which made them feel positive about their choice of early childhood media exposure. As busy mothers, most of the participants

did not have time to engage in social activities or arrange play dates for their children. In such situations, they utilized screen media to perform technology mediated activities which enriched mother-child interaction and familiarized their children with their cultural and religious background. As such, M1 used YouTube videos to stimulate her daughter's interest in physical activities such as dancing, ballet, and yoga, while M11 used screen media as a supplement to her physical arts and crafts activities with her daughter. M2 co-watched child-friendly shows with her children during their time together as a family and M5 used technology to familiarize her child with their religious and spiritual beliefs. M8 only allowed smartphone use for educational purposes, motivated by the thought of helping her child to learn about things that were not accessible due to their limited budget or inability to visit learning venues:

> *"We use it (smartphone) to show him 'dandelion' because we cannot go outside these days (due to COVID-19). One day he saw the image of a trumpet, and he really wanted to know more. We don't have an expensive trumpet, so we just showed him the cello from "Yo-Yo Ma" (world-famous cellist) on YouTube, and now he knows what is cello." (M8)*

Some participants were motivated to explore and use mobile learning apps with their children. As M2 explained:

> *"These days we are mostly staying home, so I really wanted my son to learn things that he was having in his daycare. Recently, for the very first time, my husband downloaded an app for him (son) where kids can learn alphabets, and their phonic sounds. Of course it was a learning app, but in normal circumstances we would never do that (install app for kids on phone), it is not usual or common for us." (M2)*

Participants hypothesized that the learning gains from screen media gave their children an edge over their peers who had limited exposure to screens. However, they also acknowledged that learning through screen media was a form of fast learning which left little room for thinking, problem solving, or reflection [55]. Like slow technologies [97], participants desired to have slow media which would encourage children to critically think and interact, both mentally and physically. Key recommendations included having interactive shows and apps which could engage children by asking questions and holding conversation. Having such interactivity might engage children for a longer time, giving mothers enough breathing room to attend to their duties, while preventing their children from completely zoning out while watching static programs.

Maintaining distant ties   As members of geographically dispersed families, seven of the participants used smartphones to engage their children during remote family calls to ensure that their children would become more familiar with family members, especially grandparents [81, 205], whom they did not get to see in person for months, or sometimes years.

> *"When my parents or his grandparents want to see him, we video call them and my (son) gets involved when he sees them. He also knows that they often when the phone rings its call from [home country]." (M9)*

Video-calls were the only preferred mode of communication for children [143, 144] and ensured greater engagement as family members interacted with children by showing them things of interest to get their attention [81].

> *"She (daughter) prefers an interaction with her instead of just talking. Like when my father has a cat and a dog at home, so when he talks to her, he's*

showing them to her and randomly showing other stuff to her, so she gets attentive towards that during the remote conversation." (M11)

Participants also used screen based devices to connect with friends at distance, which sometimes evolved into acquainting their children with each other through videos and pictures:

"My friend who lives in the United Kingdom asked me to send me videos of [child name] when I'm making her hairstyle or when she's doing some art work, because her daughter watches those videos and then she says I want to have my hairstyle made like her and I want to do stuff like her [...]. When I upload some videos of some art work made by [child name] on Instagram, another friend who is regularly following me says she makes her daughter do a lot of things when she watches videos of my daughter, although her daughter is six years old (older than M11's daughter), but she says its really good and inspiring." (M11)

Screen media use by children of educated, foreign mothers

The American Academy of Pediatrics (AAP) recommends against the exposure of screens to children below the age of two [116], unless it is for video chatting with a family member living at a distance [161]. For children between the ages of two to five years, they encourage caregivers to co-view educational and high quality programs with a limit of one hour per weekday, or three hours on weekend days [161, 163]. They also discourage the use of screens before bedtime or using screen media as an appeasement strategy, and recommend keeping bedrooms technology free, mealtimes for families only, and parent–child play times screen free. [116].

Screen time knowledge and implications I queried participants about their knowledge of recommended screen times and the source of that recommendation. Three participants said they did not know what the professionally recommended screen time limit was for their child's age, whereas five others reported it incorrectly. Five participants showed a certain level of confidence about their knowledge, with the sources of recommendation being children's pediatricians, the AAP, and various news articles read by the mothers. Mothers of children under the age of two (M4, M8, M9) were especially strict with their screen time limits, which is perhaps not surprising because of the young age. For the remainder, the average self-reported screen time for children was around four hours or more. Regardless of whether the child was watching it or not, TV stayed on in some households out of habit. M7 expressed her ineffectiveness towards putting recommended screen time limit into practise:

> *"We don't follow them (screen media limit recommendations) really to be honest. Like it's for one hour but I play TV for four hours for him" (M7).*

In response to the questions about parental perception on mother-child and child only use of screen media devices, participants were often pleased about their child's daily screen time compared to their age mates, based on their conversations with other parents. This was surprising as most of them self-reported their children's screen time to be more than three hours, which was already above the recommended screen time for young children. M11 reasoned about her child's screen time based on her knowledge of screen time practices of children back in her home country, highlighting that even though help with childcare is readily available in her home country (in the form of grandparents, extended family members, and house help), she believed that children there are exposed to screens more than the ones in the US.

> *"I don't really know how much children use it nowadays because it varies from family to family and country to country, but if you keep the scenario in the US in mind I have seen that (children's) screen time here is something between average and above average. But if you compare it back to kids in [home country] I have seen that mothers just let their kids go with the devices and they just forget that their kids are busy with the devices, so I would not say that it's less than average, but it is average for sure." (M11)*

The onset of the COVID-19 pandemic resulted in the introduction of new technologies and decision-making about screen time restrictions and limits for several participants whose children had attended daycare before the pandemic. Previously, M1's children spent most of the day in daycare and came back tired, wanting to eat and sleep. Although she tried to do various activities with them, she described the difficulty of stopping her children from watching TV and using smartphones very regularly. M10 stated that she was generally good with the two hour limit, but her son's screen time during the pandemic had increased due to the fact that she was the only caretaker, and had to attend several meetings online as she worked from home. For M3's child, screen time during the day increased to six hours, which included both active and passive watching.

Acceptance, ambivalence, and rejection

Perceived opportunities   Two of the participants (M6 and M11) demonstrated a more positive inclination towards the perceived benefits of early childhood media exposure. They described how they believed that their children were more advanced than their peers due to their relatively expanded knowledge about the world about them (i.e. M6 described how her son had learned many animal names and their sounds by the age of 15 months). For M11, the learning gains went beyond their own child, with her child's activities (as

shared on Instagram) serving as an inspiration to her distant friends. M1 shared her perspective on her child's technology use:

> *"Honestly technology is not something that is supposed to be in the future, it lives with us every moment, so they (children) cannot avoid it, it is a part of our lives. I know that some parents don't let their children use smartphones at all, I think that it will be hard for them in the future. I prefer that they use TV and smartphones with the control, rather than not using it at all." (M1)*

M3, whose child had a speech delay, was cautiously positive about the benefits of screen time with regards to her child's speech development:

> *"I don't know if I am being selfish or something, but I want him to improve with the words and everything [...] So I'm letting him do that (watch screen media), because according to me he is improving, and it's not even a minute difference, it's a huge difference." (M3)*

Perceived Risks Many participants showed an implicit (hinted by their disapproval of screen media choices made by other parents) and explicit dislike for early childhood media exposure, with each mother expressing their desire to reduce their child's screen time. M5 expressed that she would not have exposed her child to technology at his age if she was not so occupied with her other responsibilities. M8 thought that non-technology mediated learning was more impactful than screen media, as in her opinion children just passively watched screens without focusing or interacting with it. M6 supplemented this opinion by emphasizing the importance of parental involvement in learning, which she found to have more profound and long-term learning outcomes. M1 revealed a different concern about the possible effect of screen technologies on her daughter's speech development and

behavior. While she felt that it was beneficial in that her child was learning new words, she also expressed concerns about her daughter 'zoning' out and becoming very quiet while watching screen media:

> *"It is like she can stay in that world as many hours as you want her to be."*
> *(M11)*

A primary fear for several of the participants was to do with the potential impact on children's eyesight. Their acceptance of screen media was often proportional to the screen size of the digital device, with M11 believing that having a bigger screen size was supposedly better for the eyes, and M12 thinking that "Projector is bigger, and I think it can protect his eyes".

Moderation, mediation, and control as an educated parent   Some participants (M1, M2, M3, M6) liked having total control over their children's technology use and content consumption. While M1 controlled her children's device access by only allowing them to see TV when she played it, M6 resorted to restricting the internet access in her smartphone by putting it on airplane mode before giving it to her son. M3 had a specific playlist for her son in which she chose all the videos and cartoons that she wanted him to watch. She further added that even if the children picked the smartphone, it would be for bringing it back to the parents. She also screened everything beforehand before showing to her child:

> *"When my friends recommended I watch Blippi, I watched an episode quickly and kind of understood what it was about and then I let him (son) watch it. He sees nothing which I don't want him to watch, because I don't think it's worth-*

> *while to let your child watch cartoons without you knowing what's in them."*
>
> *(M3)*

There were certain trusted platforms (TV channels and apps) which were more favored due to their parent friendly settings. M1 preferred using YouTube kids over the regular YouTube app which allowed her to change settings to restrict content according to her children's ages. M11 trusted children's channels on Amazon fire stick and Netflix as she believed the content was pre-approved to be shown to children, and did not have many advertisements. M10 put parental restrictions on her phone to ensure that whatever her child chooses to watch has to go through her.

> *"Even for the PBS videos, if you go to another section, you have to enter some relevant questions which can only be answered by parents." (M10)*

Despite having control over their child's content consumption, participants liked keeping an eye on their watching habits. Being in close physical proximity to the children seemed to make it easier to monitor their screen media usage.

> *"Are you asking if I stand by him all the time to see what he's watching or doing? Definitely yes. The audio is so loud that I keep hearing what's being played, so if he shouldn't be watching something I would immediately go and change it." (M6)*

Overall, mothers paid close attention to the content consumed by the children per professional guidelines [116], as they believed that having proper monitoring and control strategies for screen access was more important than depriving the children of their use [106, 182].

4.1.3   Discussion

Findings from this study revealed the struggles of parenting as an international student including complex and challenging socio-cultural issues, a multitude of responsibilities, and an unequal distribution of childcare duties. More often than not, mothers put the needs of their family before their own, often compromising their mental well-being. For some, managing their multiple roles also led them to hold back on expanding their family, to handle one thing at a time, by choice or otherwise [140, 215].

Context of use

Mothers were found to be often critical of the early childhood media exposure choices made by other parents even when the motivations for that exposure were similar to their own. This led to screen time judgement, which was a reflection of their own ideals and expectations of what it means to be a 'good parent' [99]. Participants often placed at least partial responsibility for their children's challenging personality and behaviour traits to their exposure to screen media, whereas good characteristics were often primarily associated with their own efforts.

Knowledge of these changeable ambivalent feelings and inherent biases can help in designing screen media content and technologies, while incorporating these attitudinal nuances. I also report these challenges to describe mother's (often involuntary) choices of early childhood media exposure and their motivations for using screen media as a parenting tool in presenting a broader picture of their context of use. Here I argue that only describing their uses of technology and the gratifications sought from the use of specifically screen media is a story half-told, making their choices prone to judgement and criticism from others.

Despite this study's focus on the mother-child dyad, the reporting of experiences with

technology by mothers (who lived with their partners) included a window into the father's interactions with the child, and the influence of the mother's own use of technology for, and with their children. Mothers used various mediation and control strategies to regulate their children's screen media usage and their own expectations and fears regarding screen based devices used by their children. Being able to customize the device settings and screen media content from an established and reliable source (such as a popular kid's channel and content approved by fellow mothers) gave mothers a sense of relief by making them feel in control of their children's screen media consumption.

Recommendations versus praxis

The participants represented a high-literate population, where they could be expected to have considered knowledge of expert recommended screen time limit recommendations and demonstrated caution about early childhood media exposure. Children's daily screen time declared by the participants was contradictory to the recommended screen time (< two hours) for children below the age of five [126, 127]. While participants expressed their ultimate desire for reducing children's screen time, their circumstances often led them to allow screen media usage for extended periods of time, and considerably beyond the professionally recommended guidelines [116]. It was primarily because of being subjected to pre-defined gender roles, which unfortunately most often put the responsibility of housework and childcare on mothers [175], and the dilemma of adhering to their prescribed gender role as the primary child caregiver in order to establish their identity as a good parent [123]. Being subjected to stress both on the home and educational front also contributed to greater stress for mothers, which resulted in higher screen-times for children, as previously reported in the literature [**?**]. Although the use of screen media beyond the recommended screen time is common in low-income, low literacy families [45, 184**?**], the use of

screen media as a parenting tool amongst high-literate families such as these participants was revealing.

While mothers had effective strategies to moderate and monitor their children's consumption of screen media content, screen time limit recommendations were either not known, or disregarded due to the mother's responsibilities and their budgeted time. In the rare cases where they were followed diligently, it was noted that this was in instances when the mothers had help from family members who occasionally came to live with them and helped with childcare. However, having an extra family member resulted in family friction, and affected the mental health of the mothers, where they had to cope up with an additional challenge of conforming to the additional family member's concept of ideal living. The predicament was that screen watching practices before and during COVID remained similar for children of most mothers, as they were already not attending daycare, and spending time at home with screens. This called attention to systematically educate fathers/partners about the effects of unequal distribution of childcare responsibilities on mother's well-being, and to possibly revisiting the guidelines about early childhood screen media exposure based on the lived experience of parents with a lack of childcare support, in order to help mothers feel acknowledged and appreciated for their efforts.

4.1.4   Conclusion

Incorporating uses and gratifications theory as a framing mechanism, we studied international student mothers' experiences with screen based technology by investigating the context of use based on their background and lived experience, the gratifications they seek from their children's exposure to screen media, and their perceptions about the use of screen media by their children as educated, foreign mothers. Our findings highlighted

the complex and challenging socio-cultural issues, multitude of responsibilities, and an unequal distribution of childcare duties, which prompted mothers to allow extended use of screen time by their children. Mothers were found to use screen media for distraction/engagement, as a language facilitator, for incidental learning, and the maintenance of distant ties. Additionally, they also used it as a childcare proxy in the absence of co-located caregiving assistance with their young children. While I studied the experiences of this particular user group with respect to their use of screen media, I believe that the findings could also reflect the experiences not only of student mothers, but also many other types and groups of mothers and parents in the US, particularly during this extraordinarily challenging global epoch.

4.2 Technology for children at home workshop

In an attempt to understand the gratification sought by children through technology use, and to have a broader representation of graduate student parents, and parents in general, I organized and led a virtual workshop in February 2022 titled *'Technologies For Children At Home: Exploring Ways To Support Caregivers With Child-friendly Media Technologies For The Home'.* The four-hour workshop aimed to explore the common gratifications sought from children's use of technology at home through co-creation sessions facilitated over online video technoogy. I proposed this workshop at a time where researchers, teachers, parents, and designers were grappling with the role of technologies at home, as I believed exploring this nexus is an insightful opportunity for the human-computer interaction (HCI) community.

The virtual workshop was attended by 18 participants from the United States, Canada and Pakistan, including international students, US mothers in academia, international stu-

dent mothers, student fathers, and researchers in the domain of child-computer interaction. This workshop was a preview meeting for the in-person workshop accepted for presentation at the ACM International Conference on Supporting Group Work (GROUP), to held in Sanibel island in January 2023.

4.2.1   Introduction

The advent of the ongoing pandemic and related precautionary measures have confined people in their homes, with both young children and caregivers spending considerable time interacting with (or worrying about) the use of technology at home. The experience of adapting and subscribing to a multiplicity of personal and professional roles in the presence of young children at home has led caregivers to possibly change their perceptions about the use of technology for and with young children in the domestic sphere. I wanted to leverage this experience to explore their perspectives about the role of technology and affiliated media content in children's lives in the home. In doing so, I aimed to devise a rich opportunity space facilitating the design of innovative media technologies and recommendations and policies about their use by young children. The workshop had the following broad agenda items:

- Identify caregivers' gratifications sought through their own and their children's use of technology in the home, and elucidate where technology succeeds or falls short in delivering those gratifications.

- Leverage workshop participants' personal and professional personas to establish ways in which technology can optimally help deliver the sought gratifications.

Call for participation

Submissions were invited from caregivers, researchers, and practitioners working in the research domain of technology and media for children discussing topics around the role of technology in young children's life in the home, gratifications sought by caregivers through children's use of technology, successes and failures of current technologies and media in providing sought gratifications, the tensions and connections between screen media and voice agents, novel ways to communicate and interact with emerging technologies in the home, and empirical research studies in this area, including critiques of current practices of research in this domain. Submissions could be structured in multiple ways, including (but not limited to) abstracts, position papers, pictorials speculative fiction pieces, opinion pieces, case-studies, or a summary of participants' interest and experience in this research space. I welcomed participants who did not want to submit a workshop paper, but had been in a position as a designer or researcher of technology for children. Additionally, I encouraged academic parents who did not study this space, and researchers who studied children's technology, but were not parents themselves to attend because of their personal connection to the workshop theme.

4.2.2 Virtual workshop delivery

Prior to the virtual meeting, I invited participants to introduce themselves informally through Slack channels created for the workshop. They were encouraged to introduce both their professional and personal personas by sharing their recent research or updates about family life during the pandemic. Participants were also encouraged to solicit ideas from children in their households about what they like/want screen based media and technology to have in order to promote more inclusion from children who could not participate in the

workshop themselves.

I initiated the virtual meeting with the description of the structure and goals of the workshop, followed by organizer introductions. During an ice-breaker activity, participants introduced themselves by describing their positionality and giving a brief discussion of their workshop paper or relevant work, and what they wanted to learn or aim to contribute to the workshop. After the introductions, groups of 3 participants were joined by one or two of the workshop organizers in individual breakout rooms to engage in an affinity diagramming session facilitated by Google Jam-boards to discuss and identify common gratifications sought by caregivers through their young children's use of technology, perceived gratifications sought by children in their own use of technology, technology used to deliver sought gratifications, and the pain points or limitations of their experience. After this 30 minute activity, participants reviewed and discussed the common gratifications and limitations identified by each group in a communal activity, to stimulate thought for the next component of the workshop. After a 10 minutes break, groups of 3-4- participants (lead by 1-2 of the organisers) reflected on the gratifications sought by caregivers to identify emerging needs and ways of supporting caregivers through technology. Each group engaged in discussions to describe research approach(es) to understand emergent uses of technology by caregivers and children at home, and the perceived opportunities in designing technology for children at home by leveraging features from existing technologies for children. After this activity, each group summarized and presented their findings to the workshop audience, which was open to critique, comments, and suggestions by remaining participants. The workshop concluded with a plenary activity where the participants shared their closing thoughts and remarks about the workshop theme and agenda.

4.2.3 Group insights

After transcribing all the notes generated from the breakout sessions, I performed a top-3 analysis to generate prominent themes across the discussion cues. Each of them are detailed in table 4.2, 4.3 and 4.4, and described in detail in the subsequent sections.

Caregivers' gratifications sought through their own and their children's use of technology in the home,

Technology	Media
television	subscription streaming services (PBS kids, Amazon Kids, Disney Plus)
touch screen devices	online video sharing and social media platforms
smart speakers	video games

Table 4.2: Popular choices in terms of digital devices and media

Children	Caregivers
fun	distraction, solitude, personal time, retreat, survival, childcare assistance
learning	learning, education, tech education, digital literacy
bonding with parent	cultural and heritage preservation

Table 4.3: Primary gratifications sought by caregivers, and perceived gratifications sought by children through their use of technology and media

Perceived threats and pain points

Participants expressed their frustrations regarding the constant customer culture producing tech addicts, which tends to exploit children's data through profiling and monetizing. These ethical concerns were attributed to news about data about children being sold by big companies like Amazon and Google. They shared their concerns about data privacy

and lack of visibility in terms of selection and presentation of digital content to children. They believed that not having enough access could allow children to run into questionable material if not observed by parents. They also indicated that nascent media presented a simplistic and stereotyped version of the world, which lacked representation and diversity. They viewed the lack of representation of their respective cultures to be a hindrance to transferring cultural values to their children and perceived acceptance of different cultures as a threat to their children's identity formation.

Perceived threats	Pain points
profiling and monetizing	controlling access
age inappropriate content	displacement effects on children
stereotypical world view	expectation gap

Table 4.4: Pain points in the process of obtaining gratifications from technology, and the perceived threats by the use of media by young children

They attributed these perceived threats to access issues and to not having enough parental controls, which could enable them to supervise their children's use of technology and to do item selection for children. In addition to these, the technology addiction seemed to yield a high sedentary lifestyle, which resulted in other behavioral issues such as displacement effects and the unpleasant responses of children when technology failed or was taken away. They believed that the digital divide and inter-generational gap between adult caregivers and children created an expectation gap, which resulted in conflicts between the gratifications sought by caregivers and children.

4.2.4   Action items

Participants in our workshop agreed that most of the parents concerns can be addressed by even mediocre design, but their limited voice in the design of technology and media put

them at a disadvantage especially in an advertisement economy where children are seen as easy consumers and target audiences. By no means did the workshop cover an exhaustive set of thoughts and activities on this research topic. However, the participants asked some important questions, which can be a basis of exploration during the upcoming in-person component, or the next series of this workshop. They are listed here:

- How do parents feel about the tech choices they make for themselves, and for their children?

- What is screen time? How much screen time? Is there a limit to screen time? What is 'healthy' screen time?

- What are the potential long-term issues of early childhood media exposure in today's world?

- Can access to technology at a young age lead to polarization from childbirth

- How can tech and media be more culturally inclusive?

- How can we make tech companies listen to parents' and caregivers' concerns and expectations regarding their children's use of technology?

Chapter 5

Technology to facilitate parenting of young children
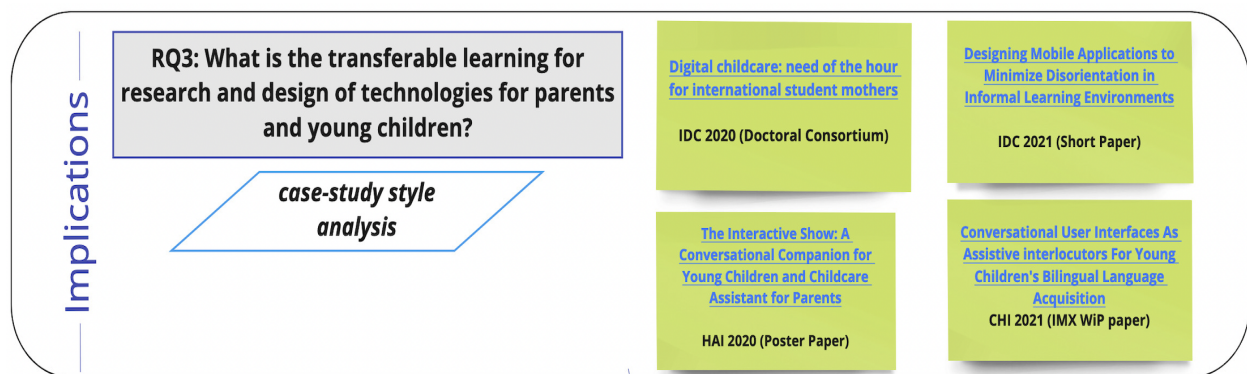
Figure 5.1: Chapter 5 highlights the various roles in which technology facilitates international student parenting, and the opportunities that exist within this space to design technologies for parents of young children

5.1 Roles of technology in foreign student parenting

The findings highlighted the complex and challenging socio-cultural issues, multitude of responsibilities, and an unequal distribution of childcare duties, which prompted mothers to allow extended use of screen-based technologies by their children. For the most part, current technologies were able to deliver the gratifications sought by mothers through their children's use of technology and media. However, obtaining some of the gratifications they

sought from technology were to some extent limited by their technological experiences due to their unique circumstances and needs. Mothers were found to use technology for distraction/engagement, as a language facilitator, for incidental learning, and the maintenance of distant ties. Additionally, they also used it as a childcare proxy in the absence of co-located caregiving assistance with their young children. Table 5.2 defines the key gratifications sought from technology, and the corresponding roles that current technologies were able to fulfil, or have an opportunity to fulfill. Each of these roles is described in detail in the subsequent sections.

Primary gratification	corresponding role of technology
Self-care	Childcare proxy
	Parent support network
Connection	Remote relatives
	Remote parents
Learning	Secondary language learning
	Introducing cultural and religious values

Table 5.1: Primary gratification sought from technology, and the corresponding role which technologies fulfill or have an opportunity to fulfill. Important to note that while mothers were able to obtain their primary gratifications through existing technological solutions, they are band-aid solutions to larger, systemic problems.

5.1.1 Technology as a childcare proxy

The mothers in my study population practice childcare in ways which were usually unheard of by their ancestors, mainly because of the major shift in their lifestyles for accommodating studies and work. These practices included using screen based technology to occupy children [21], or working from home in the wake of the COVID-19 pandemic. Mothers' use of technology seemed to converge with children in more ways than their partners due to being co-located with them for a longer period of time, where technology often acted as a reliable childcare assistant [21]. While the mothers wanted to spend time and

engage with their children throughout the day, the budgeted availability of time regularly forced them to seek ways to engage the children for a prolonged period and while away from their attending mother. They often found themselves in a position where they had to distract or engage their young children using technology due to the urgency of their work, the affordability of digital devices in the US, the intuitive nature of the devices themselves, and being able to watch over their child alongside them while they completed their own necessary house chores and academic responsibilities. Although many instances of mothers use of screen-based devices as a support structure [99] fail to comply with the AAP recommendations for young children [116], the mothers' challenging circumstances often called for desperate measures. This quandary urges researchers to explore the potentially controversial, yet unappreciated benefits of using technology as a childcare assistant.

Young children (the ones in our studied age range) often seek their mother's direct attention and assistance repeatedly throughout the day, both for genuine and impulsive reasons. These children are naturally liable to give in to their emotional states when faced with disruptions in the regular flow of events, resulting in disruptive behavior [106]. In that regard, I found potential in developing technology and media which can help mothers avoid possible time-consuming behavior disruptions, while keeping the child seamlessly engaged so that they can continue working without interruptions. Diversionary apps and programs are especially desirable when mothers are studying, as disruptions to the flow of their thoughts can disorient them during their work/study sessions at home [22], jolting them out of focused concentration as they tend to their children's untimely demands of attention.

5.1.2   Technology to connect with remote family

The majority of the mothers in the study hailed from Asian countries. Given the geographical distance, they were typically only able to visit their homes sporadically due to financial and visa concerns. Living away from family and without the friends they grew up with compelled the participants to use screen based devices to communicate with their essential familial and fraternal networks from a long distance. Born in the US without a physically co-located extended family, the children of these mothers recognized family and acquaintances primarily as faces on a smartphone screen. While it is not an ideal introduction, the mothers really wanted their children to cultivate close relationships with their grandparents, cousins, uncles, and aunts.

Traditionally, video-calls are popular for connecting children with members of their geographically distributed families such as grandparents, incarcerated parents [198], and migrant parents with children who remain in the homeland[83, 84]. However, the interest of children in conversing with people who don't share the same space with them physically depends greatly on their mood, objects of interest, and the level of interactivity offered by the person on the screen. A child's short attention span can be upsetting both for the parents and the person with whom they want the child to interact. I note this to urge designers to explore the various opportunities for developing screen based games which can help in facilitating conversation and interactivity between children and their distant relatives. Augmented reality/mixed reality games [132] can give children a deeper impression of their conversation partners by sharing the same space as them, thus possibly producing greater levels of engagement. These communications can have a positive impact on the mother's perception of her child's para-social relationship with screen media characters, as in this instance, they would instead be communicating with known people of emotional significance.

5.1.3   Technology as assistive language aid

Many mothers were raising children who spoke more than one language [19, 41], where they often struggled to acquaint their young children with their local language if the child spent the majority of time at home, and with their spoken language if they attended day-care or school. Due to the challenges that can arise for these children in terms of communicating with other children in the primary country language, developing relationships with distant relatives in other languages, and a lack of opportunities for practising additional languages within a small community of speakers [41], a previously less recognized use of technology as a language aid emerged among such mothers. Mothers reported having minimal spoken communication with or in the presence of their children, and they usually did not have co-located extended family members, who could converse with the children using their native language. They used technology to both acquaint their children with their parent's native language and to also help them become proficient in English owing to their US context [19]. Technology also aided mothers whose children had delayed speech, despite the concerns about screen-based technology inducing slow language development and speech delay in children [39, 103]. While the use of voice user interfaces as children's bilingual communication aids appears in the literature [19, 223], I believe that the potential of technology as children's assistive interlocutors for secondary language learning, while living in a family unit consisting of limited members, has not been completely realized as of yet.

5.1.4   Technology to introduce religious/cultural values

Living in a country which is culturally different than their home country, the mothers often felt that their children were missing out on learning and knowing about their parents'

culture. They felt that their children were not encountering enough elements of their parents' culture in their daily life at home and/or in caregiving facilities. In my research, I encountered mothers who had to go back to their home country after completing their graduate degree, and children who were born outside of the US but traveled to the US with their mothers in the first year of their lives. For both of these scenarios, the mothers felt the need for educating their children about their cultural roots. They used screen media to receive this gratification, where they played their chosen movies, videos and songs to customize children with their culture. These movies, songs and videos often introduced children to popular food, apparel, language, religious beliefs, and places of historical significance for their mothers. While the mothers were often able to find screen media content to obtain this gratification on streaming services, not all cultures or religions were sufficiently or appropriately represented in popular screen media. Many parents in the workshop commented about the lack of representation of their heritage in popular shows, where they found themselves struggling with acquainting their children with their values. Considering the case of children born to international student mothers, I found potential for developing technology and media which can aid parents in introducing their cultural and religious values to their children who live in communities with limited members of similar cultural origin.

5.1.5 Technology as a parenting support network

Mothers in my research were often subjected to *screen-time shaming*: judgement about allowing children to access screen-based technologies at an early age. The ambivalent feelings about technology outweighed their own understanding of their circumstances and perceived benefits of their children's early childhood media exposure. Despite being knowledgeable and aware, the mothers were often trapped in a recommendations versus praxis

situation, where allowed screen-time for their children went far beyond the professional recommendations for allowable screen-time for children. Over time, they harbored negative feelings of guilt and shame about their decisions surrounding the use of technology, which affected their mental health and well-being. It appeared that the lack of connection between mothers in a similar living situation deprived them of the validation that they needed for their choices and decisions when it came to their children's use of technology.

Research suggests that peer support programs for parents of children with special conditions can be effective against stress and anxiety [102, 178], and can be a means of emotional support to parents [157]. Keeping participant's involuntary practice of comparing their performance as a mother with others in differing roles, and subjecting themselves and others to screen-time judgement, I envision an *anonymous screen-time log* application, where mothers can log their child(ren)'s daily screen time. The logged data can both be displayed individually (and anonymously) for each household, and also aggregated and visualized to give insights about screen media usage in a general household with young children and busy mothers. The anonymity may help in avoiding possible screen-time judgement, while also being able to observe the routine of other families in a similar living situation. Considering that the mothers admitted that not all screen-time was bad, especially when it delivered the gratifications they sought (listed in table 4.3), it is important to realize that it is the need of the hour for them, rather than a superfluous parental luxury. It is hoped that the (possible) theory vs praxis of screen time recommendations would enable mothers to have a positive feeling about their choices, potentially leading to acceptance of technology in a positive and constructive way. Additionally, the application could incorporate features such as an *ambivalence canvas*, which may allow mothers to reveal their hesitations and potential regrets regarding their parenting, especially with regards to their children's screen media usage. Mothers can be as creative as they wish with their

input, using their preferred form of expression from text, to audio, or drawing. It may allow them to explore their ambivalent or conflicting thoughts while also connecting with others who share their lived experience. It is hoped that being aware of these ambivalent thoughts and having a platform for sharing them may enable parents to bond over their communal context of use of screen media and potentially contribute to their overall well-being.

5.1.6 Technology as a band-aid solution

Findings also illuminate how mothers handled childcare as primary caretakers and sometimes lone parents, and their willingness – and at times, helplessness – towards using technology as a childcare proxy. They talked about the early childhood screen exposure choices they made, which at times were not in line with the professional recommendations [2, 163] due to the unconventional circumstances that they lived in. The controversial role of technology as a childcare assistant is not commonly admitted by parents, partly due to their own guilt for their choice of early childhood media exposure and partly (and relatedly), because of the actual or perceived judgemental views of other parents, especially those with a slightly more privileged living setup (e.g., living near family or close friends who offer help for childcare and/or being able to afford third-party childcare services).

While technological solutions currently provide support to mothers' parenting practices, they are band-aid solutions to systemic problems such as the lack of affordable childcare, inflexible schedules, and unsympathetic consideration of female students' living situations. Deciding to have children during graduate studies (which ought to be a private choice) often entailed personal sacrifices on the part of mothers, limiting them from extending their family while being a graduate student mother in the US. This was consistent with research

findings where mothers have to pay the baby penalty [141, 218] while juggling their many identities (of a mother, wife, and student) in and outside the home. Structural changes, including departmental support and affordable childcare, can enable student mothers to make empowered decisions regarding extending their family, and/or spending more time with their children, due to this much-needed support.

5.2 Implications for research

Findings from my work highlight the inter-dependency of mothers and their young children during their interaction with technology. Mothers were the primary caregivers of children even in the case where they had a co-living partner, and thus had a greater influence and control on the technology and media use by children. Although children's preferences and needs influenced mother's selection of platform, device, or media for their children, they still held an authoritative position over their young children's media consumption by actively moderating their usage. In this position, they assumed the responsibility of curating their children's use of technology and media (Table 5.2).

5.2.1 Primary caregiver and young children's dyadic use of technology

While children may seek certain gratifications from technology such as self-soothing and entertainment, the gratifications sought by primary caregivers through their children's use of technology go beyond these two gratifications, which influence the ways in which they allow and navigate their children's access to technology. Therefore, in the context of media use by young children at home, mothers are the passive users and active seekers of gratifi-

cations from screen-based technology, and their choices are influenced by several intrinsic and extrinsic motivations, altering their context of use (figure 5.2).

Thus, the research and design of technologies for very young children (newborns, toddlers and preschoolers) involves designing for dual audiences [36]. I argue that when designing technologies for children, it is also important to have a thorough understanding of children's primary caregiver's motives, beliefs and knowledge about the use of technology by young children. Research in this domain should also consider the primary caregiver's role as gatekeeper and direct receiver of gratifications from technology. As gatekeepers, they control the access to technological devices and media based on their understanding of professional recommendations about early childhood media exposure, their past experiences with technology use as a child, and the availability of help and assistance with their parenting activities.

5.2.2   Effect of children's use of technology on primary caregiver

While the majority of mothers noted positive effects of early childhood media exposure in their children such as intelligence, language assistance, and access to knowledge, it was also noted that children's extended use of screen-based technology engendered feelings of guilt and shame in mothers about their own parenting. In consideration of mothers' ambivalent feelings, research on technologies for children should also account for the broader effects of technology use by children on parents' health and well-being. Policy recommendations about technology use by young children should consider the supervisory and gatekeeping role of caregivers and parents, and strive to engage them in the design of policies to reflect realistic expectations and caregiver preferences about the use of technologies by young children.

5.2.3   Participatory asset-based approach to engage caregivers

While establishing the importance of my intended user group, I came across their unique capabilities which could be resourceful in my own research. Although the mothers were not necessarily experts in my domain of research, I expected them to be experts in the context of their domestic environment which was being researched, and their scholarly experience as graduate student made them valuable contributors to different aspects of my own explorations, instead of being mere research subjects. Based on these findings, I propose that the research on caregivers' preferences about access to technology at a young age should should endeavour to have a rich and thorough understanding of the context of technology use by the caregiver-child dyad by involving the primary caregiver(s) at every step of the way. Instead of adopting a need-based approach to developing new and improved technology for children, designers should first attempt to understand the patterns of use and non-use of technology by caregivers and children. It is essential to adopt an asset-based approach, where instead of researchers adopting a position of authority, they should leverage caregivers' assets such as their position as experts of children's behavioural patterns concerning technology, and their privilege in observing and reporting children's needs and sought gratifications pertaining to technology to produce richer insights about the context of technology use to inform its design and usage policies.

5.2.4   Primary caregiver's role in research and design of technology for young children

Although prior research suggests different roles that children may have in the design of technology [70, 95], most of it is focused on the roles of children aged four and above. Moreover, the corresponding roles of adults defined by [225] refer to 'researchers' as 'adults'.

By engaging mothers as resourceful participants and co-researchers, I identified additional roles that primary caregivers can play in the research and design of technology and policy recommendations for young children (Table 5.2). The studied age range of children in this dissertation could only contribute to the design process as users and testers due to their limited abilities to express their preferences and needs explicitly [36], where mothers (and interested fathers) facilitated the test scenarios, and communicated their children's needs pertaining to technology. Given the small age of the children and assuming that their caregivers are in a higher power dynamic in the domestic settings, they are able to define young children's unique needs as an adult facilitator or interpreter. They can also assume the role of ambassador by eliciting the responses and needs of very small children, or children with special needs.

Domain	Caregiver's role
Uses of technology	Gatekeeper and curator
Research and design	Facilitator, interpreter and ambassador

Table 5.2: Roles of caregivers in the uses, research and design of technology for young children

5.3   Implications for technology design

In this section, I describe my propositions based on insights from the literature and findings from my work. These design propositions are developed with consideration of the supervisory role of mothers who are active receivers of the gratifications provided by technology through their young children. They are intended to serve as non-exhaustive, high-level technology blueprints which can serve as assistive parenting tools. In proposing the design opportunities, I strive to make them generalizable to a broad set of parents including student parents raising young children in a different country, working mothers, and single

parents living without co-located family.

5.3.1   Digital Childcare Assistant

In the following sections, I present some desired design elements in a digital childcare solution suggested by mothers' uses and gratifications of technology use with young children[1].

Seamless Engagement: Children are naturally liable to give in to their emotional states when faced with disruptions in the regular flow of events, resulting in tantrums [106]. Care-giving systems should be able to maintain engagement while diverting the child's attention away from the parent for them to be able to attend to their work. In case of a meltdown, the system should be capable of having backup strategies to seamlessly engage children so parents can continue working without interruptions.

Parent Involvement: Although daily circumstances may keep mothers direct attention away from their children for prolonged periods of time, they also may want to be updated about their child's activities while they keep up with their work. A prominent feature of the system should be saving and summarizing the caregiving session for subsequent reporting to parents. Caregiving systems can also suggest followup activities for the parents and children to perform later in their time together. It would not only answer parent's concerns about the child's safety, but would also encourage additional parental involvement.

Affordability   One of the reasons for mother's use of digital technologies and media is its cost-effectiveness as compared to baby-sitters and daycare centers. Although the quality of care provided through a digital caregiving service is obviously not comparable

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[1]A version of this section has been published as a CHI 2021 workshop paper [25]

to other childcare services (baby-sitter, nanny or daycare), it can be relatively low-cost through the utilization of commonly available digital devices.

Edutainment: Some parents want the caregiving session to have some added value such as providing education or entertainment (or both) to the children, especially if it is for a longer period of time. The caregiver could propose different online activities with varying levels of active supervision, i.e. a story telling app could entertain and help vocabulary building for a pre-school child while a drawing game could engage a two to three year old.

Future directions

Although using digital technology and media as a caregiving assistant is assumed to be safer than letting the child go outside without supervision, it still has its shortcomings in terms of safety and privacy [117, 171, 186, 206]. In cases where the child is engaging in physically dangerous behaviour, the parents need to be immediately alerted by the system to get their attention. A record of the caregiving session for parents to watch later can ensure both safety of children and can provide feedback to keep parents in the loop in an unobtrusive way. Credentials of the child such as location and name need to be anonymous to the system to reduce the threats of exploitation in case of a data breach. Future research in this area can examine the type of activities and content that can be presented to children in this age group according to their attention span, physical and mental (dis)abilities, and parent preferences with different levels of active supervision. Specific concerns for digital childcare for children with different abilities is also a notable future research prospect.

5.3.2   Conversation partners

Makers of *Bandersnatch*, an interactive episode of Netflix's popular series Black Mirror first tested the idea of interactive storytelling in a children's show. They developed a format called "string of pearls": a main spine for the story that branches out to four possible endings [156]. Based on that, they produced a show with branching narratives for children in programs like *Puss in Book: Trapped in an Epic Tale* and *Buddy Thunderstruck: The Maybe Pile*, in which the child would reach a point in the story where they get a binary prompt to select with a remote control. [7, 189]. Based on their work, I present a proposition for an interactive show which can be a conversation partner for children between two to five years of age [2], as children in this age range tend to naturally interact with agents [69].

With a team of two other researchers, I encapsulated the desired features of an interactive show as being *understanding* or giving the impression of being understood, recognizing the verbal and emotional cues to provide relevant *response*, and maintaining an uninterrupted conversational *flow* by picking up the voice cues of young children. These characteristics would distinguish it from conventional conversational shows for children by creating a symmetry in the conversation. These features combined with the problem domain of a child feeling misunderstood with current child-focused programs allowed us to have an extended brainstorming session to make real our design thinking [100]. Since I envisioned making use of the interactive show as a positive distraction, engagement and reduced distractions were the primary point of concern. The fact that the show is conversational can help in addressing concerns about screens inducing slow language development and speech delay in children [103].

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[2]A version of this section has been published as a poster paper in the Proceedings of the 8th International Conference on Human-Agent Interaction [23]

Human-in-the-loop

The most reasonable way for producing such a show seems to have human involvement at some point. Shows like Word Party (Netflix) use two humans to put each character's movements together; one who works neck down for the bodily actions of the character, and one who controls the head including expressions and voice of the characters [14, 187]. Instead of making the show pre-scripted, the person responsible for voicing the character can change the script in the moment, based on the child's responses. For instance, when the character asks for the child's name, the response can be quoted back in the reply. Similarly, the character can make appropriate pauses to hear the child's response, and concur or politely correct them depending them on their answers. Professional voice artists can be hired to play the character, who stay in the background while a cartoon character portrays them in front of the children. It is similar to a video call, except that it is scripted and has an educational focus. As the script will be adapted for each child, this show will be a one-on-one program especially played for one child at a time. People performing the character can opt for different scripts, content and age groups of children, which will help in matching them with the child who wants to watch the show.

Having a human-in-the-loop [226] can potentially reduce content scalibility issues by having professional voice artists to play the character by staying in the background, while a cartoon character portrays them in front of the children. Instead of making the show pre-scripted, the person responsible for voicing the character can change the script in situ based on the child's responses.

Future directions

Although privacy is a general concern when dealing with anything which can potentially track and store information, the concept of having an AI element to interact with children through a show encompasses many opportunities not only for children, but parents as well. Since AI can *learn* children's behavioural patterns over time, parents can be informed about problematic behavioural patterns that might need their attention. It can also be used to track the developmental milestones of a child (both behavioral and/or physical) to either detail progress or delays, promoting parent involvement. The fact that the show is conversational also helps in addressing concerns about screens inducing slow language development and speech delay in children [103]. With its capabilities, the proposed AI can also act as a remote childcare assistant for parents with little or no help at home in situations including international emergencies and pandemics including the recent outbreak of COVID-19.

5.3.3 Conversational User Interfaces (CUIs) for language learning

Recent research shows that some parents use screen media content to acquaint their children with their parent's native language, and to also help them become proficient in the language of communication in the country that they reside in [19]. However, in the US, much screen media content with animated characters (popular examples:*Dora the Explorer, Mickey Mouse Clubhouse*) as well as human characters (popular examples: *Blippi, Mother Goose Club, Blue's Clues*) provide a form of interactivity and incidental language learning for young children primarily in English. It is also noteworthy that having a conversation partner in a true sense has a different meaning to children than adults, as at-

tributes of conversation which are valued by adults such as trustworthiness and establishing common ground are not relevant to young children [50]. Instead, children value the familiarity [111, 208] and interactivity [23] offered by screen media characters which are not a part of present day CUIs. Children also struggle in communicating with conversational agents (CA) due to grammar and language complexity [19]. Although parents seek opportunities for using technologies to expand their children's communication skills and learn another language [19], the functionality of switching languages is not available in state-of-the art CUIs.

I explored this understudied domain by investigating the capability of CUIs as an interactive language aid for young children two to five years old) that can help children learn a secondary language in the absence of an interlocutor[3]. I adopted a three-pronged approach while focusing on the aspects of dialogue that need to be *different* from the conversational flow with adults. I first reviewed relevant literature on children's interaction with voice agents. Next, I analysed responses from the interviews with mothers in the US raising young bilingual children. Finally, a group of three researchers met to discuss and encapsulate the design goals of a CUI for young children in an ideation session [23] based on the literature, requirements of the user population, and my own experience as a mother as well as a keen observer of her bilingual preschooler's screen media watching sessions.

Future Directions   With an initial exploration in the domain of CUIs as assistive interlocutors for young children, I presented a preliminary, yet prioritized list of high-level objectives which can guide the design of CUIs to aid bilingual children's secondary language learning. The application of such a CUI is beyond language learning by bilingual children, and can branch out to learning a language as part of curricular requirements for older chil-

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[3]A version of this section was published in the Proceedings of the ACM International Conference on Interactive Media Experiences (IMX '21) [27]

Goal	Description
Language chunks	communicating in simple, decomposed language.
Familiar language scaffolding	training the conversational agent with familiar voice, talking style, and commonly used words from their native language.
Contextual appropriateness	contextually appropriate, where context can be a child's age, mood, or developmental milestones.
Social communication cues	secondary language speaking interlocutor in a multi-person dialogue.
Code switching and accent variations	attuning the conversation to children's code switching and accent variations.

Table 5.3: Design goals for a conversational user interface which can aid young children's secondary language learning as an assistive interlocutor

dren. Due to the preliminary nature of the work and restrictions of scope, the proposed design orientations are relevant to CUIs which are used exclusively by children, hence we do not account for situations which can have multiple people from the same household interacting with them [112]. Future work in this domain should investigate the impact of culture on the interaction of bilingual children with a CA [133]. Further research can also investigate the prospects of using CUI in conjunction with screen media to promote a greater level of engagement of children with the virtual interlocutor.

5.3.4 Educational mobile applications for children's informal learning

Children are observed to be more engaged in their learning tasks while using digital technologies [118], especially mobile applications [44, 71, 118, 190]. Mobile technologies have the potential to provide *seamless learning*, defined as "ubiquitous access to mobile, connected, personal, handhelds, creating the potential for a new phase in the evolution of technology enhanced learning, marked by a continuity of the learning experience across

different environments." [43]. I used a science festival as a situated context to inform the design of educational applications for children [4]. During a child-focused science festival, participants were asked to try a mobile app (figure 5.5) crafted for performing a nature-related learning task. The science festival attracted an audience of 6000 people, primarily children with their parents or adult caretakers, making it a suitable venue for exposure to informal education.

Discussion

In this section, we discuss some important considerations for the design of educational applications for minimizing disorientation for elementary school aged children's informal learning.

Co-participation with parents: Science festivals are optimal places to initiate and engage in joint activity with peers [37]. We found in our observations that not only peers, but parents were highly interested in interacting with children during learning tasks. This phenomenon was not observed with children who came with other adult chaperones such as teachers, probably because of the greater level of comfort between the family members. We expand on the findings by Canovan et al [37] by encouraging the design for co-participation with parents, considering their supervisory role in children's activities outdoors. Designing collaborative technologies which can engage parents in monitoring children's progress or aiding them through indirect contact with the child (via parallel participation using their own device) can pivot parent's attention towards the task, subsequently minimizing their child's disorientation. It can help to take parent's direct attention away from the child, which is a cause of disorientation. Additional research is required to ac-

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[4]A version of this section was published in the Proceedings of the 2020 ACM Interaction Design and Children Conference [26]

count for complex factors such as promoting parent's engagement with the activity, assuring child's learning gains in the co-participation, and safety concerns of taking parent's direct attention away from the child.

Interactive learning: Children became disoriented during longer sessions of instruction in the informal learning environment, much as they do in classroom settings. While the prospect of using mobile phones with an element of interactive learning excited them, they tended to be more focused once they had an objective such as capturing pictures, directing their attention to the task because of the sense of autonomy it provided. Based on our observations, visitors to a science fair are looking for opportunities for learning as well as activities that stimulate scientific inquiry. Educational applications which strike a balance between incorporating elements of entertainment and learning seem to engage and orient participants for a longer time [42]. Thus, a mobile application designed for imparting learning in informal learning environments should be able to hit the sweet spot by incorporating short bursts of equally spaced instruction inter-weaved with hands-on activity, which can not only help in orienting children towards a task, but also make them more active learners while making the best use of limited time allowances.

Minimalism We noticed that having minimal controls in the app made it easy for children to navigate the task in the science festival, hence it is important for child-oriented educational apps to reduce navigational choices for children to help them focus on the learning task. Incorporating intuitive yet simple and interactive notifications such as progress bars and sounds which are apt for a certain age group in instructional apps may be able to orient participants towards the task in a minimalist yet meaningful way. Additionally, considering time as a constraint while learning in an informal learning environment also puts emphasis on designing shorter and more engaging instructional content. Utilizing multime-

dia elements such as audio and video for imparting informal education with only essential text, and using camera and sound recorder of mobile devices for quicker collection of data for assessment or sharing can enable the efficient use of time for learning activities.

Feedback and reflection   Learners are on a time budget while performing activities in an informal learning environment, and prefer receiving the results of their actions immediately. For instance, having automatic image recognition which could detect the correct attempts in our mobile application could have helped to instantly reward children accordingly. Participants were also curious to see their score, showing disappointment in not being able to self-position themselves amongst the others. Elements of reflection which can nurture the natural tendency of children to see how well they do with respect to others seemed to be a desirable element in an educational mobile application. Educational learning applications for informal learning environments should thus provide immediate feedback and reward to the children to help them stay rooted to the learning task for a longer time. Our findings also indicate participants' interest in knowing where they are located with respect to others. Exploiting the natural competitive nature of children with design elements displaying progress and participants' performance may help in orienting children towards their task. It can also be used as a deliberate effort to support the notion of reflection during learning.
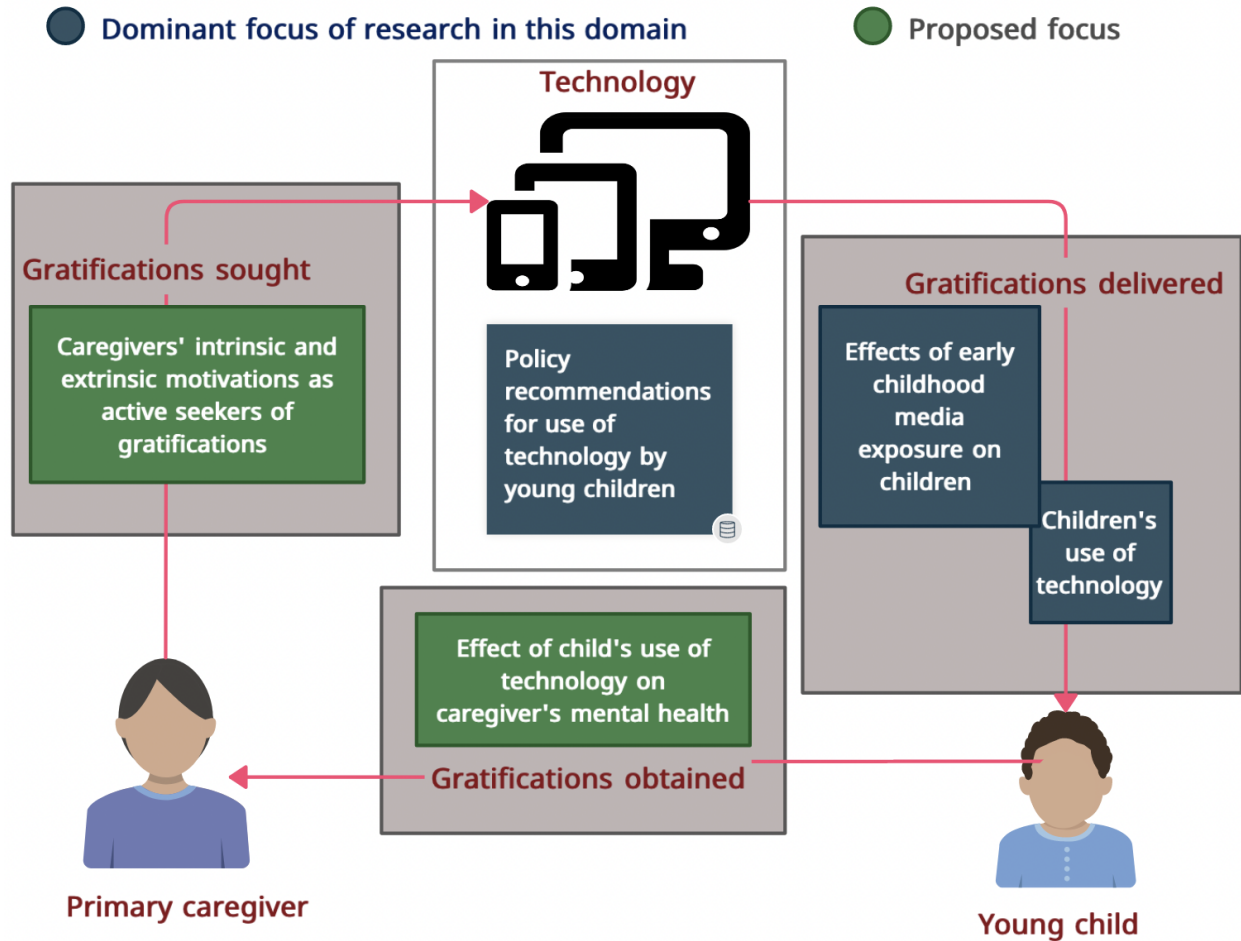
Figure 5.2: Visual depiction of the interconnection between the caregiver-child dyad during their interaction with technology, where the direct users (young children) and the seekers of gratifications (primary caregivers) are different but interdependent entities. Based on these assumptions, the blocks in green specify the proposed research focus in the domain of parent-child interaction with technology
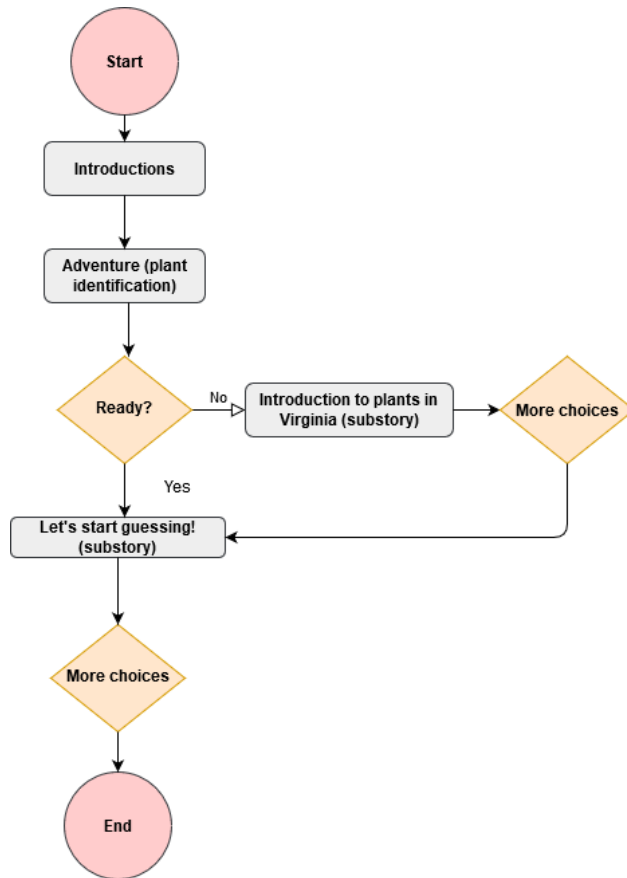
Figure 5.3: A story-map for an episode of "The Interactive Show"

Figure 5.4: Cartoon character having an interactive conservation with the child
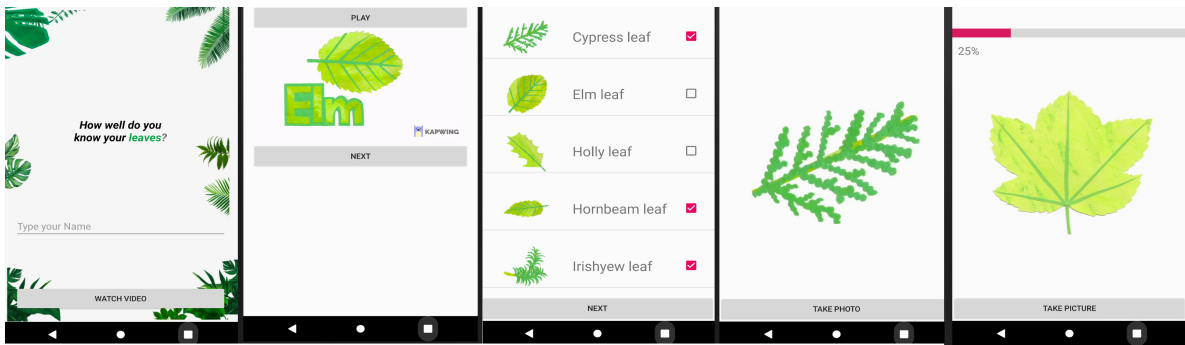
Figure 5.5: Progressions in the mobile application designed to facilitate children's learning in an informal learning environment such as science museum

Chapter 6

Conclusion and Future Work

6.1 Conclusion

With my work, I present the caregiver-child dyad as distinct but interdependent entities during their interaction with technology, where caregivers are active seekers of gratifications from technology, whose sought gratifications are influenced by several factors, altering their context of use. While the uses and gratifications approach assumes that users are active consumers making deliberate media choices, very young children are often not capable of making conscious media choices, which makes them more dependent on parental preferences. By engaging primary caregivers in in-depth efforts of understanding of their motivations and perceptions about early childhood media exposure, I set forth the praxis between professional recommendations and actual lived parental experiences with technology and young children. Building on these insights, I present a conceptual framework for research which considers the dyadic use of technology by primary caregivers and young children due to their close relationship.

I also present a new angle of understanding about participatory design methods, which involves stakeholders at various stages of research by utilizing their unique capabilities and strengths and adapting and refining methods according to the stakeholders in order to maximize the gains from their participation. Based on the various roles of technology in international student mothers' lives, I then present implications for designing technologies

including screen-based digital childcare assistants and interactive shows, conversational user interfaces as bilingual language learning partners, and applications to support young children's incidental learning, which can assist parents in their caregiving duties.

6.2   Anticipated impact

I foresee my dissertation work to impact three groups.

- **To researchers**: I present implications for research in sensitive settings by adapting conventional participatory research methods and utilizing the strengths possessed by a user group.

- **To designers**: I provide preliminary recommendations for designing technologies for parents and young children, and open up this design space by generating ideas for future research in the domain of parent-child interaction with technologies.

- **Broader impact**: I strive to make the methods and approaches in this work generalizable to broader populations of parents and caregivers including working mothers, mothers without childcare support, mothers of children with special needs, mothers who are trans and/or have same-sex partners, international student mothers outside the US, and parents of young children with limited support.

6.3   Generalizability of the findings

Since my work is comprised of case-study style analysis of in-depth understanding of a particular group of users, there are certain limitations to my work in terms of scope and findings, which have the potential for further study. The majority of my dissertation work

is focused on international student mothers in the US, with primary representation from mothers from Asia and Africa. While the work was strengthened by the representation of mothers from various ethnic groups and the diverse perspectives of collaborators from various research backgrounds on the research team (multiple parents and non-parents alike from diverse countries), I did not have representation of students from all continents. It is worth mentioning that I participated in multiple professional conferences, workshops, and a doctoral consortium[1] with student parents and researchers in the domain of child-computer interaction from several parts of the world including Europe, the United Kingdom, and Asia, who felt deeply about the issues addressed by my dissertation work. Nevertheless, the experiences of international student mothers in the US are likely somewhat different from mothers engaged in study elsewhere, requiring additional work to verify the generalizability of my findings.

This dissertation work was primarily conducted during the COVID-19 pandemic, which might have an impact on my findings. However, work in chapter 3 covers various aspects of mothers' struggles as foreign graduate student mothers, surfacing also the role of technology in different stages of their lives. While the individual narratives are presented as snippets of the everyday life of a foreign PhD student mother, when read together as a whole, they give much more contextual information about the choices and technologies used by mothers and young children, providing an holistic and longitudinal view of their lives. Although mothers in my study population were responsible for the majority of childcare and domestic duties, and held authority on decisions around their children's screen media usage as their primary caregiver, there is a need to investigate the co-use of technology by fathers/partners with their young children to give a holistic view of the family practices around technology use.

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[1] Workshop for PhD students from all over the world who are in the early phases of their dissertation work

6.4   Future work

Building upon the findings from my work and in consideration of the bounded scope of this dissertation, I outline my long and short term research agenda in the following sections. The subsequent sections progress from defining work that is currently underway and is expected to complete in the upcoming year, to work that is anticipated to continue over the course of my career to fulfill my overall research vision.

6.4.1   Using Amazon Glow device as a parenting assistant

With the surge of digital devices with children as primary users, it is important to examine how commercial devices which are developed for children as primary users support their design claims and impact. Leveraging some primary gratifications identified through previous work, I designed a study which aims to use commercial screen-based devices as a parenting assistant. The primary objective of this study is to understand how commercial screen-based technologies can be used to engage young children, and where they succeed/-fail at providing a sense of communication and engagement. The secondary objective is to analyze parents' perceptions of using these technologies in engaging their children, learning from a remote person/character, and for connecting with remote family members. I reviewed the existing interactive devices with the following criteria based on the primary gratifications identified in table 4.3:

- Designed for children as primarily users (to allow self-care for caregivers).

- Support remote calls (for connection).

- Have interactive activities (for learning)

Figure 6.1: A young child engages in interactive activities such as trying to completing a puzzle using Tangram Bits included with the Amazon Glow device bundle

Based on this criteria, I selected Amazon's newest child-friendly device called *Glow*, which comprises a projected space and camera that allows young children to communicate with a remote loved one in a way which feels more immersive than a traditional video call using a smartphone or tablet device. This device is designed for children aged three years or older, and hosts a variety of games, books, and art to engage children while they communicate with their remote family members. The device bundle includes seven *Tangram* puzzle pieces of varying sizes, which can be used to complete a variety of puzzles. The children may choose the puzzle they want to solve with the help of the remote loved one while they assist and encourage them while they attempt to complete it. The puzzles are designed to provide a suitable challenge for young children, with a hint feature to assist them whenever they get stuck. At the end of the puzzle, the object animates making the experience delightful for the child. The device also allows children to convert their favorite toy or object into a digital image/sticker to be used within an art activity or for merely being amused by seeing the object incorporated into the activity. The children can also read, play, draw, and participate in several activities using a large repository of books, games

and puzzles provided with the device through a subscription to Amazon Kids. The curated content courtesy of Amazon Kids subscription with no advertisements makes it a relatively safe virtual environment for young children. The fact that the Glow device is not enabled by Alexa [170] or compatible with Echo Glow makes it more trustworthy for a parent who wants to avoid the recording and storage of their children's voice and video interactions on the cloud. The device features a large selection of activities which can be performed alone or with a remote contact (child or adult), and the novelty factor of the device and interaction is bound to keep children attracted to the activities. It has multiple potential uses beyond connection with remote loved ones, such as remote learning and language assistance [24].
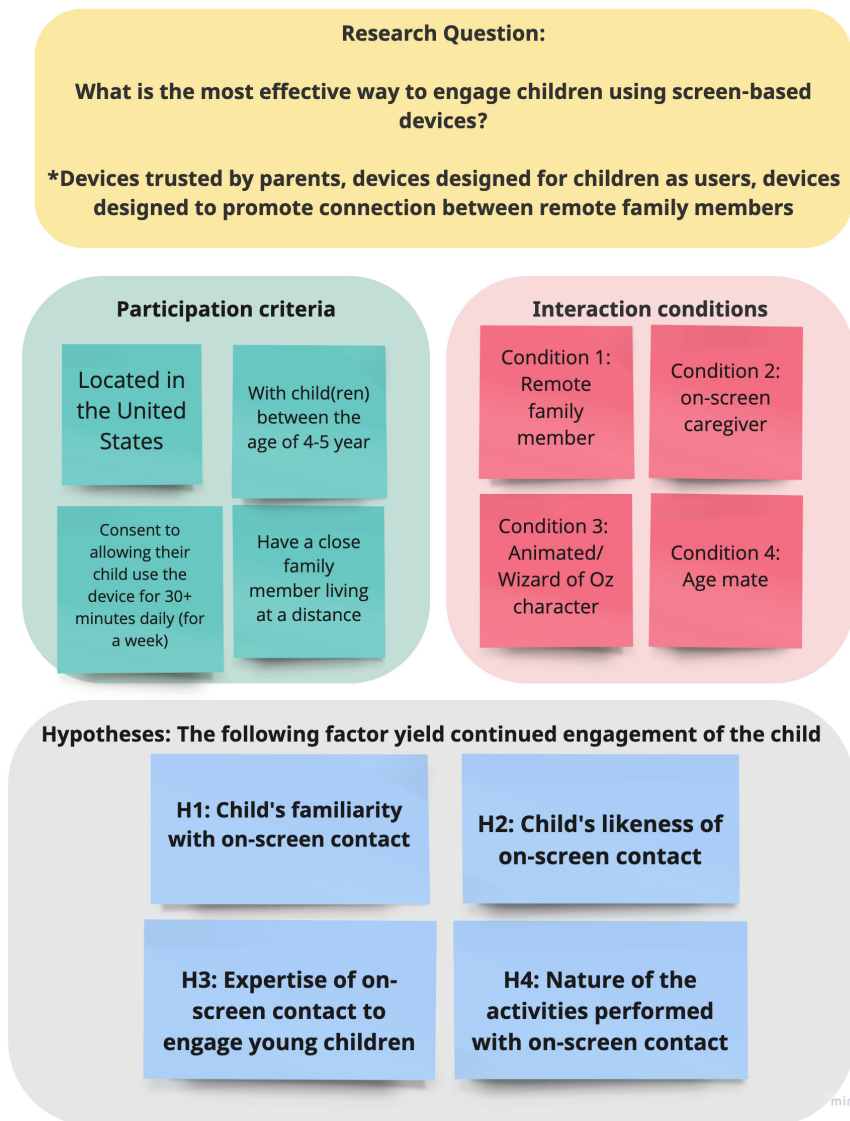
Figure 6.2: Detailed study plan for evaluating Amazon Glow (a commercial screen-based device designed for children) as a tool to engage children with remote contacts

Currently, I am completing pilot testing to streamline the study design, after which I will recruit families with young children to use the device for connecting with remote family members and professional caregivers. The participants will perform the interactive activities (example pictured in figure 6.1) offered by the device such as reading books, completing puzzles, playing games and doing art together, to evaluate the device's effective-

ness in engaging the children. These activities will include a child's engagement with a remote family member, an on-screen caregiver, an animated character, and a 'wizard of oz' character/puppet. Each of these activities will be performed in the presence of a parent, where the on-screen person or character will engage the child in different sessions using the unique device features including reading a book, solving a puzzle, or making art together. The detailed study design can be seen in figure 6.2. After using the device for a week, families will participate in a follow-up interview to understand their experiences and perceptions related to the use of this device, and their suggestions for improvement of their experience with such child-focused commercial devices which aim to bring people from around the world together in shared immersive digital spaces to connect, learn, and experience.

In the future, I plan to replicate this study with other commercial screen based devices (such as Facebook Portal) to complete a comparative analysis of their performance with children at home. The end-goal of this project is to produce design guidelines for interactive media and devices for children which can assist parents in engaging their children for short periods of time, while making remote interactions meaningful and valuable.

6.4.2 Fostering a community of researchers and designers of digital childcare technologies

The workshop discussed in 4.2 was a warm-up activity for the GROUP workshop scheduled for January 2023, and it brought together various researchers, practitioners, and parents in the domain of child-computer interaction research in one place. To further the research objectives outlined in 5.2, the primary goal for the workshop is to engage this community's personal and professional personas (which are their assets) to initiate conversa-

tions about caregiver and children's use of technologies.

As a first step towards creating and facilitating long-term research connections between participants to foster a sense of community, Slack and discord channels will continue be used before, during, and after the workshop for information sharing and promoting engagement between the participants.

To leverage participants experience in this domain, I plan to invite them to contribute longer versions of their workshop papers as book chapters to be included in a book on the research and design of technologies for children at home. In an attempt to facilitate continued conversations around this topic, I also aim to consolidate the ideas generated from this workshop by proposing a special issue track in the upcoming SIGCHI conference with select workshop position papers. Additionally, participants from the in-person workshop will be invited to collaborate on research articles on the emerging issues and trends from the workshop. Participants will also be encouraged to share thoughts and ideas generated from the workshop among their networks of policy makers in the caregiving and tech industries, and to append questions, comments and suggestions on a living Miro board shared with participants via workshop Slack channel.

Finally, I plan to write a proposal to receive funding for providing childcare services to the attendees, which can encourage them to attend the workshop with their children. While the workshop structure and activities will mostly be identical to the virtual component, it may give greater opportunity to understand children's perspective if they accompany their caregivers. Building on the ideas generated from the virtual workshop, I plan to co-design with young children with the help of their adult caregivers, which I believe is going to mimic the *parenting while working* environment encountered by caregivers at home.

6.4.3 Exploring parent-child interactions with technology in the global south

I am intrigued by the limited representation and lack of consideration of the needs and uses of technology by children in the global south, especially in South Asia, despite it being home to around 627 million children under 18 years of age, who make up about 36% of the total world population [211]. In my experience of participating in various professional ventures, most of the work in interaction design and children and child-computer interaction stems from North American and European countries, with a larger representation of researchers from countries in that region. With my move back to my home country of Pakistan, I am excited to explore the nuances of parent-child interactions with technology in the global south, including the perspectives, challenges, and opportunities that exist within that society. By venturing in this domain, I aim to have a broader representation of children from that region, and spark interest in research on child-computer interaction particularly in Pakistan.

6.5   Final thoughts

'It takes a village to raise a child'

With my work, I accentuate that as the world becomes a global village, the village that helped with raising a child has also become digital, where the use of technology by caregivers is becoming prevalent in modern parenting practices. But unlike asking close family and friends for childcare assistance, taking help from technology in childcare often comes with the notion of incompetent parenting, cultivating ambivalent feelings in caregivers. I strive to challenge this notion by considering ways for approaching the design of tech-

nologies for young children by having an holistic understanding of caregivers' technology context of use and incorporating caregivers' preferences, sought gratifications and values to develop confidence in their everyday technological choices. Having that confidence, I believe, can contribute towards a healthier ecosystem of caregiving for young children.

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Appendices

Appendix A

IRB Approval Forms

MEMORANDUM

DATE:	April 6, 2020
TO:	Scott McCrickard, Neelma Bhatti
FROM:	Virginia Tech Institutional Review Board (FWA00000572, expires October 29, 2024)
PROTOCOL TITLE:	Digital Caregivers for Children: Need of the hour for International Student Mothers
IRB NUMBER:	**20-016**

Effective April 6, 2020, the Virginia Tech Human Research Protection Program (HRPP) and Institutional Review Board (IRB) determined that this protocol meets the criteria for exemption from IRB review under 45 CFR 46.104(d) category(ies) 2(ii).

Ongoing IRB review and approval by this organization is not required. This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these activities impact the exempt determination, please submit a new request to the IRB for a determination.

This exempt determination does not apply to any collaborating institution(s). The Virginia Tech HRPP and IRB cannot provide an exemption that overrides the jurisdiction of a local IRB or other institutional mechanism for determining exemptions.

All investigators (listed above) are required to comply with the researcher requirements outlined at:

https://secure.research.vt.edu/external/irb/responsibilities.htm

(Please review responsibilities before beginning your research.)

PROTOCOL INFORMATION:

Determined As:	**Exempt, under 45 CFR 46.104(d) category(ies) 2(ii)**
Protocol Determination Date:	**April 6, 2020**

ASSOCIATED FUNDING:

The table on the following page indicates whether grant proposals are related to this protocol, and which of the listed proposals, if any, have been compared to this protocol, if required.

SPECIAL INSTRUCTIONS:

*** The Virginia Tech IRB/HRPP has requested that research involving person-to-person contact or gatherings of human research participants be paused as soon as possible. The duration of the pause is unknown, but to reduce disruption to the extent possible, we will be reassessing daily. Although we continue to issue approval notices, Virginia Tech guidance should be followed. Please visit https://www.research.vt.edu/covid-19-updates-impacts.html for updates.

Date*	OSP Number	Sponsor	Grant Comparison Conducted?

* Date this proposal number was compared, assessed as not requiring comparison, or comparison information was revised.

If this protocol is to cover any other grant proposals, please contact the HRPP office (irb@vt.edu) immediately.

MEMORANDUM

DATE: March 16, 2020

TO: Scott McCrickard, Neelma Bhatti

FROM: Virginia Tech Institutional Review Board (FWA00000572, expires October 29, 2024)

PROTOCOL TITLE: Disorientation and outdoor learning tasks

IRB NUMBER: **20-017**

Based on the submitted project description and items listed in the Special Instructions section found on Page 2, the Virginia Tech IRB has determined that the proposed activity is not research involving human subjects as defined by HHS and FDA regulations.

Further review and approval by the Virginia Tech HRPP is not required because this is not human research. This determination applies only to the activities described in the submitted project description and does not apply should any changes be made. If changes are made you must immediately submit an Amendment to the HRPP for a new determination. Your amendment must include a description of the changes and you must upload all revised documents. At that time, the HRPP will review the submission activities to confirm the original "Not Research" decision or to advise if a new application must be made.

If there are additional undisclosed components that you feel merit a change in this initial determination, please contact our office for a consultation.

Please be aware that receiving a "Not Research" Determination is not the same as IRB review and approval of the activity. You are NOT to use IRB consent forms or templates for these activities. If you have any questions, please contact the Virginia Tech HRPP office at 540-231-3732 or irb@vt.edu.

PROTOCOL INFORMATION:

Determined As: **Not Research**
Protocol Determination Date: **March 16, 2020**

ASSOCIATED FUNDING:

The table on the following page indicates whether grant proposals are related to this protocol, and which of the listed proposals, if any, have been compared to this protocol, if required.

Invent the Future

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
An equal opportunity, affirmative action institution

SPECIAL INSTRUCTIONS:

The project proposed does not meet the federal definition of research. While it is a systematic investigation, the project was part of a class project and will not contribute to generalizable knowledge.

This therefore does not meet the federal definition of research which is: A systematic investigation, including research development, testing and evaluation, designed to. develop or contribute to generalizable knowledge.

Our guidance on data collected for class projects is that the data must be deleted after the semester over. The data cannot be retained for future use, but the instructor can retain de-identified data for future course use.

Date*	OSP Number	Sponsor	Grant Comparison Conducted?

* Date this proposal number was compared, assessed as not requiring comparison, or comparison information was revised.

If this protocol is to cover any other grant proposals, please contact the HRPP office (irb@vt.edu) immediately.

Division of Scholarly Integrity and Research Compliance
Institutional Review Board
North End Center, Suite 4120 (MC 0497)
300 Turner Street NW
Blacksburg, Virginia 24061
540/231-3732
irb@vt.edu
http://www.research.vt.edu/sirc/hrpp

MEMORANDUM

DATE: April 1, 2022

TO: Koeun Choi, Scott McCrickard, Neelma Bhatti, Derek Anthony Haqq, Aisling Kelliher, Jisun Kim

FROM: Virginia Tech Institutional Review Board (FWA00000572)

PROTOCOL TITLE: Children’s use of Amazon Glow device for Engagement and Distraction

IRB NUMBER: **22-001**

Effective April 1, 2022, the Virginia Tech Institution Review Board (IRB) approved the New Application request for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report within 5 business days to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at:

https://secure.research.vt.edu/external/irb/responsibilities.htm

(Please review responsibilities before beginning your research.)

PROTOCOL INFORMATION:

Approved As: **Expedited, under 45 CFR 46.110 category(ies) 6,7**
Protocol Approval Date: **April 1, 2022**
Progress Review Date: **April 1, 2023**

ASSOCIATED FUNDING:

The table on the following page indicates whether grant proposals are related to this protocol, and which of the listed proposals, if any, have been compared to this protocol, if required.

Date*	OSP Number	Sponsor	Grant Comparison Conducted?

* Date this proposal number was compared, assessed as not requiring comparison, or comparison information was revised.

If this protocol is to cover any other grant proposals, please contact the HRPP office (irb@vt.edu) immediately.

Appendix B

Inviting and facilitating collaboration

Dear [name], I (met)/(found you through) [source]. I wanted to invite you to write a collaborative, autobiographical paper with you for a human computer interaction conference. My research focuses on designing distraction technology, like conversational agents in TV shows, and technology that can help mothers, specifically international student mothers who raise young children without familiar support systems. I was wondering if you would be interested in writing a first hand impression of your own life, including your experiences with technology as a parenting assistant as a foreign graduate student mother of a young child in the US. I consider it as an interdisciplinary collaboration, where you might (if relevant) count this publication towards your degree progress. We can complete this over summer, and I have funding to provide 50$ to each collaborating co-author. Only criteria for this is to be a non-US born/international student mother passionate about voicing her opinions about her young child(ren)'s use of technology. If you are interested/have time, let me know so I can hit you up with more details. That said, I understand that academic moms already have their plates full, so it's okay if you'd like to pass!

Writing cues

- **Intersection of multiple identities**: How was your life before coming to the US/becoming a graduate student mother? Why did you decide to pursue a graduate degree? Why did you decide to have/raise children during graduate studies? What's the role/perspective of your partner ? Do you plan on having more children during graduate studies (why/why not)?

- **Technology as a parenting assistant**: What is the role of technology in your parenting? What are some of the limitations of your experience with technology use by and with your children?

- **Perceptions of early childhood media exposure**: How (if at all) COVID-19 has affected your routines and behaviours about the use of technology for or with your children? Your overall needs or vision, like and dislikes about technology, something that you wished to have in past or in future?

Appendix C

Supplementary intimate narratives

Baby makes three: D started her PhD at 22 and was on track to build her academic career. Everything was put on hold after marriage. She was promised that she would have an opportunity to finish her degree. But is it not a woman's place to compromise? Though she grew up in a family with modern ideologies, societal values forced her to make choices against her wishes. After multiple miscarriages, there came a rainbow baby. As a naive 24-year-old, she had failed to understand that when you marry a man from a traditional family, you marry his family too. She was an afterthought even before the marriage *henna*[1] had erased from her hands; Taken for granted, career aspirations put on hold, and be a prop in her spouse's arms. But she thought to herself, "What marriage is without its strife?"

Union of souls, separation of bodies: The pregnancy period was accompanied by lots of health challenges that made A defer her trip twice. Three months after delivery, she had to take the most difficult decision of her life. She was left with two options; to stay back and lose the admission or to leave her husband and child at home while she pursued her career. Upon careful analysis, she and her husband decided that she would accept the admission offer with her husband promising to take care of their three-month-old child back home. She wept so bitterly at this decision, but knew she had limited chances to advance her education. Their decision did not go well with some people who felt she was

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[1]the powdered leaves of a tropical shrub, used as a dye to color the hair and decorate the body. (Oxford languages)

too heartless to have abandoned her family, especially her three months old because of her studies abroad.

Apprehensions : She desired to get married, but her mind was crowded with the stories and news about marriages that ended in divorce. This increased her fear to the point that she doubted finding a good man. However, it was not too long that she found her soulmate who meant the whole world to her. Their love grew and the bond between them was so tight. Though she and her soulmate loved each other so passionately, things were not very smooth because they had some opposition from members of their families. They were not perturbed as they were able to overcome the hurdle. The family eventually approved their relationship, and the marriage preparation began in earnest.

Lucky Stars Shining Bright : During the uncertain times of their relationship, she had applied for a scholarship abroad to get away from what life was throwing at her at that time. Coincidentally, the approval from parents, scholarship letter, and offer letter for the government job that she had been trying to land from several years all came together. Fast forward to when they got married after what seemed like eternity, she conceived within the first month.

High Bar : She was then faced with the choice of availing the scholarship and moving abroad while being pregnant, or staying back home where she might never decide to pursue a PhD. The former involved experiencing childbirth and postpartum duties without familial support while continuing studies with a *desi* partner who had only seen everything from a glass of water to a belt in the *shalwar* (trouser) being ready for his father (and brothers), handed in a silver plate by her stay-at-home, immensely adept mother-in-law. She had only given birth to one child at the age of 30 (that too delivered with a ce-

sarean section aka easy birth), and had no chances of having another one until completing her PhD. On the other hand it was her mother-in-law who had also given birth (naturally) to four healthy children (3 of them boys) before her mid-thirties, while perfectly juggling all the responsibilities of being a good wife, mother, and daughter-in-law in a huge joint family system.

Decisions not made lightly : While this was going on, she got some overseas full scholarship admissions she earlier applied for. It was a beautiful and joyous moment for her and her soulmate. This shortened the period of wedding preparation that they had to get married within two weeks. She did not miss her first month after the wedding, she conceived that same month while preparing for her graduate program abroad. However, she dwelled on the thought that she would be separated (physically) from her husband so soon.

Hodgepodge of decisions : As she was rocking her 17 day old baby, she made a choice that night. No matter what, she would protect her baby from the binds of patriarchy. She would raise her baby to stand up for herself and make her own choices. Mistakes help us grow and she chose growth for herself and her child. She wanted to finish her doctoral degree and help train women like her to stand up for themselves . She prayed, she cried but she knew she had to leave her heart back home to make a life for both of them. She had the support of her parents and her family, especially her mother who offered to take care of her child despite her deteriorating health. At the age of 29, she walked away with nothing material but most consequential to her life: Her self-respect.

Tinderbox: Becoming a first-time parent in a new country, with her spouse arriving roughly one month before her expected delivery date, with no social support and money,

and a qualifying exam in two months while exclusively breastfeeding? Sounds fun. Highly ambitious. Except that their relationship became a tinderbox. They knew it was going to be difficult, but they were naively hopeful. The level of difficulty B faced was beyond her expectations, making her question the decision of moving to the US. Why was a PhD so important, why could she not be just a stay-at-home, rather stay-in-the-home-country-with-family mom? She fed the baby, pumped milk for the baby when she left for classes, bathed and put the baby to sleep, prepared meals, and studied. But was she really studying, or just barely making it to the next assignment deadline? On one of those nights, she burst and told the husband she doing all the heavy-lifting, and slowly sinking under a load of self-imposed expectations of being a good wife, a good mother, and a good student. In that order.

Love, again : She was driven, focused and terrified to fail. She worked hard and familiarized herself with technology that was eons ahead from when she left her training behind. Late nights led to late discussions with a lab mate and a bench mate. Love was brewing but was she paying attention? Sometimes you just take the plunge and that is what she did! She met and introduced families oceans apart across *Zoom*. Marriage happened but followed immediately by the sad demise of her mother, and her daughter's caretaker. What was supposed to be a slow integration of family became a forced interaction of living under the same roof. Grief and self-doubt were her new friends.

Baby Fever : She did not remember how old she was, yet vividly remembered the dream in which she was pregnant, and that craving of feeling a child inside her consumed her for the coming years. The catch was due to her religious beliefs, she did not want to have a child without being legally married. And she did not meet her soulmate until she was 26. The first thing that she told her (now) husband when he proposed was that she wanted

to have a baby immediately after they get married, and it genuinely freaked him out. Of course, this is not something you expect to hear in response to a romantic proposal, as if the pressure is not already enough. But she thought her clock was ticking, so she desperately wanted to experience motherhood.

Unable to extend family without extended family: Earlier in life, A had hoped that she would complete her family size in her thirties so that as a young mother, she would grow with her kids. Life, however, said otherwise; her decision to pursue a PhD restricted this noble dream of hers. While the thought of baby demanding less attention from her if he has siblings to play with lured her occasionally, she knew it was not possible as long as she is in the USA as a graduate student. It would be too demanding academically, emotionally, financially, and physically to manage a large family alone in the USA without family support.

A bigger family: C and her partner had always wanted more children, but she always got upset when he raised the topic and felt that he was being inconsiderate of her situation as a graduate mom raising their son all by herself, haunted by trauma of the past when she found out she was pregnant again when baby was fourteen months old. While she hoped that her one of her school applications would be successful, she worried about being in a situation where she had to start graduate school in a foreign land while having to care for a baby and a toddler. She tried being optimistic, yet life took a sudden turn when the doctor reported that the fetus had stopped growing. She decided to go ahead with an evacuation procedure without contacting her partner or any family member, experiencing excruciating pain and shivers for hours after the process without pain relief medication which could not be covered by her insurance. She was later supported by friends who came by the hospital to take her home, though she cried for months, picking herself

up when time to move to America approached.She now gets scared at the thought of being pregnant again without family support while coping with stress of graduate school. Perhaps when the pressures of graduate school are over, then her mind would be ready to birth a newborn.

Culture shock   : Her idea of America was twelve months of bright and sunny days. The people were nice and friendly, most of them willing to help a stranger, but no one told her of the imminent darkness and a winter that would last for months. She could not afford a daycare close to her school so she would take two buses and walk fifteen minutes to a daycare that was affordable. There were days when water trickled from baby's nose as they journeyed to the bus stop waiting endlessly for a bus that usually would often run late. Luckily, they survived that winter without any illness, but this would be a defining moment for her, being without family and lacking immediate support.

Student parents   D's partner decided to move to another state for his graduate studies, this had always been his dream and she was in support of it. Although it meant he would be far from the baby, they still made it work by using social media to communicate. This was the same way she related to family back in her homeland, social media was the only way she could get baby to see and recognize grannies, aunties and uncles; the baby barely spoke to them, but he smiled when they sang to him and praised him for his artworks.

It takes a village   : For several days, they yearned for an extra pair of hands who could hold the baby while they napped peacefully, or just walked outside together for 5 minutes without worrying about her. With two out of three members of the family being extremely light sleepers living in a single bedroom apartment, if she vowed to take care of baby without disturbing her husband, he would wake up immediately with hearing the baby cry, and

if he volunteered, the baby would need her to be fed in less than half an hour. Plus the husband did not know how to cook, at all, so she had to cook meals at home as they ate *Halal* (denoting or relating to meat prepared as prescribed by Muslim law).

Bridging the geographical distance Her daughter was suddenly uprooted after her fourth birthday and brought back to a new and unknown environment. Her baby was an American but raised internationally. There were struggles, tears and tantrums. But calling apps made it easier to stay in touch with family back home. Her daughter knew that family and her loved ones were one touch away.

Cartoons vs humans At the time B left for the US for her graduate studies, smartphones became the means of communication with both her husband and her three months old baby back home. Sometimes, the baby would not be interested. When she travelled back home, it took a few days before her child could recognize her. This made her feel so bitter and gave her teary eyes. With this experience, she decided to take the baby along with her to the USA. When abroad, she kept her baby in touch with father, grandmother and other family members using the smartphones. Even at that, her baby preferred watching cartoons to seeing humans.

Appendix D

List of Publications

- **Neelma Bhatti**, Amarachi Blessing Mbakwe, Sandra Nnadi, Geetha Saarunya Clarke, Aakash Gautam, D. Scott McCrickard, Aisling Kelliher. "Intimate Narratives: An Assets-Based Approach To Develop Holistic Perspectives of Student Mothers' Lives and Their Use of Technology in Parenting." The 25th ACM Conference on Computer-Supported Cooperative Work and Social Computing. Virtual. October, 2022.

- **Neelma Bhatti** , Lindah Kotut, Derek Haqq, Timothy L. Stelter, Morva Saaty, D. Scott McCrickard, Aisling Kelliher. "Parenting, Studying And Working At Home In A Foreign Country: How International Student Mothers In The US Use Screen Media For And With Their Young Children." The 24th ACM Conference on Computer-Supported Cooperative Work and Social Computing. Virtual. October, 2021.

- **Neelma Bhatt**i , Timothy L Stelter, D. Scott McCrickard, Aisling Kelliher. " Conversational User Interfaces As Assistive interlocutors For Young Children's Bilingual Language Acquisition." ACM International Conference on Interactive Media Experiences. Virtual, June 2021.

- **Neelma Bhatti** , Morva Saaty and D. Scott McCrickard. " Designing Mobile Applications to Minimize Disorientation in Informal Learning Environments (Best Short Paper Honorable Mention Award)." The 2020 ACM Interaction Design and Children Conference. Virtual, June 2021.

- **Neelma Bhatti** , Timothy L. Stelter and D. Scott McCrickard. "The Interactive Show: A Conversational Companion for Young Children and Childcare Assistant for Parents." The 8th International Conference on Human-Agent Interaction. Sydney, Australia. November 2020.